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## THE HORMONAL INDUCTION OF HOMOSEXUAL BEHAVIOR IN THE SPAYED FEMALE GUINEA PIG\*

WILLIAM C. YOUNG, PH.D., AND BREWSTER RUNDLETT, A.B.\*\*

HOMOSEXUAL BEHAVIOR by normal females which resembles the copulatory behavior of the male is commonly displayed about the time of heat by the sow (McKenzie, 10), the cow (Hammond, 6), the guinea pig (Young, Dempsey, Hagquist and Boling, 16), the rabbit (Hammond and Marshall, 7) and occasionally by the rat (Long and Evans, 9, Hemmingsen, 8). Although such behavior has not been observed in the normal ewe, it occurred in four ewes injected daily for 82 days during the anoestrus with 200 rat units of the estrogen, Progynon-B (McKenzie and Terrill, 11).

When this behavior is being displayed by female guinea pigs, the animals pursue other females or even males, mount them and go through the motions of copulation except that they do not afterward roll dorsally and clean their genitalia. For convenience this behavior has been referred to as "mounting activity" (Young, Dempsey and Myers 12, Young, Dempsey, Hagquist and Boling, 13).

Interest in an investigation of its relationship to the heat response and in the factors which might be involved in its display was stimulated when it was realized that mounting activity and the heat response are distinct and separable components of the overt heat behavior. In fact, in the cycles of a few

animals one regularly occurs without the other. As a result, in any study of sexual behavior neither may be used as a measure of the other; they must be recognized as entities, related in point of time, but not necessarily quantitatively.

As a first step in the investigation an attempt was made to induce this behavior by the injection of hormones. Estrogens alone and androgens either alone or in combination with estrogens were generally ineffective. However, when estrogens were followed by progesterone the percentage of animals which mounted corresponded well with the percentage of normal animals which mount. It was postulated, therefore, that these hormones acting synergistically are responsible for mounting activity as well as heat in the normal female (Young, Boling and Rundlett, 14, Young, Dempsey, Hagquist and Boling, 16).

The data on which this hypothesis are based have never been published, nor have the results of more recent supplementary experiments. These data and those obtained by Dr. Ball (1) are the first, to our knowledge, to be obtained from an experimental study of this part of overt sexual behavior in laboratory rodents.

In the investigation 206 spayed female guinea pigs have been used. Except for a few details of techniques common to all experiments, the procedures employed will be described with the experiments of which they were a part. All hormones were dissolved in corn oil (Mazola) and all injections were sub-

\* This investigation was supported by a grant from the Committee for Research in Problems of Sex, National Research Council.

\*\* Arnold Biological Laboratory, Brown University, Providence, Rhode Island and Laboratories of Primate Biology, Yale University, New Haven, Connecticut.

cutaneous. The interval between experiments in which animals were injected was never less than two weeks. Usually a recovery period of three weeks was allowed. When it was desired to compare the extent to which estrogens alone and estrogens followed by progesterone induce mounting activity, the animals

was given by Dr. John L. Boling, Messrs. William R. Fish, James G. Wilson and Arnold L. Soderwall and the Misses Harriet Chamberlain and Dorothy Trumbull. Estradiol benzoate (Progynon-B), progesterone (Proluton), testosterone (Oreton) and testosterone benzoate (Oreton-B) were generously

TABLE I  
EXTENT OF MOUNTING ACTIVITY FOLLOWING INJECTIONS OF ESTROGEN AND ESTROGEN-PROGESTERONE

Number of injected animals		Extent of mounting activity			
		Following estrogen injection		Following estrogen-progesterone injection	
		Number of animals which mounted	Number of completed attempts to mount	Number of animals which mounted	Number of completed attempts to mount
12	50 I.U. estradiol benzoate + 0.1 I.U. progesterone—after 36 hours	0	0	11	170
30	50 I.U. estradiol benzoate + 0.1 I.U. progesterone—after 48 hours	2	5	22	197
31	50 I.U. estradiol benzoate + 0.1 I.U. progesterone—after 48 hours	3	3	20	223
14	50 I.U. estradiol benzoate + 0.1 I.U. progesterone—after 48 hours	2	7	10	212
13	50 I.U. estradiol benzoate + 0.1 I.U. progesterone—after 72 hours	3	9	5	67
31	50 I.U. estradiol benzoate + 0.1 I.U. progesterone—after 73 hours	6	55	14	164
22	4 × 12.5 I.U. estrone + 0.1 I.U. progesterone—after 48 hours	2	11	16	141
23	4 × 12.5 I.U. estrone + 0.1 I.U. progesterone—after 48 hours	5	78	10	147
		Average number of completed attempts to mount per animal			12.2

were observed continuously during the interval between the estrogen and progesterone injections and after the progesterone injection until all sexual activity had ended. After it was found that estrogens alone stimulate relatively little mounting, continuous observations were not begun until immediately following the progesterone injection.

Assistance in observing the animals

supplied through the courtesy of Dr. Irwin Schwenk of the Schering Corporation and estrone (Theelin in oil) through the courtesy of Dr. Oliver Kamm of Parke, Davis and Company.

#### EXPERIMENTAL

In general, three procedures were employed in the attempts to induce



mounting activity. Estrogens alone were injected, estrogens were followed after a suitable conditioning interval by progesterone, and androgens alone or in combination with estrogens were administered.

Early in the work when we were more interested in the induction of heat no accurate records were kept of the

ing activity was displayed by 23 which made an average of 7.3 completed attempts to mount, range 1 to 63 (Table I). The latent period varied from 33½ to 69½ hours although most were less than 48 hours. When the same animals were injected with 0.1 I.U. progesterone 36 to 72 hours after the initial injection of estrogen, mounting activity

TABLE OF ESTROGEN-PROGESTERONE INJECTIONS AND MOUNTING ACTIVITY

ANIMAL NO.	4	8	10	15	21	22	23	24	26	28	33	34	36	37	39	41	43	44	45	46	47	48	49	57	69	71	73	77	89	95	HALF-HOUR	MOUNTS PER
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FIG. 1. Protocol from an experiment in which the number of completed attempts to mount is shown after the administration of 50 I.U. estradiol benzoate followed 48 hours later by 0.1 I.U. progesterone. The beginning of heat is indicated by the heavily outlined squares.

mounting activity displayed by animals injected with estrogens alone. The impression was gained, however, that they were effective only irregularly even when quantities up to 1000 I.U. were injected. This opinion was confirmed by the results from experiments during which 176 animals given estrogens were observed continuously for 36 to 72 hours after the injections. Mount-

ing activity was displayed by 108 which made an average of 12.2 completed attempts to mount, range 1 to 89. The latent period varied from ½ to 10 hours, whether the interval between the estrogen and progesterone injections was 36, 48 or 72 hours. The 72-hour group was established in order to make allowance for animals in which the latent period for heat following injections of estrogens

exceeded 48 hours. Nevertheless, the result was the same; the proportion of animals stimulated by the injection of progesterone was still much larger than

which estrogen and progesterone were injected is reproduced (*Fig. 1*). The relative ineffectiveness of estrogen in inducing both heat and mounting ac-

TABLE II  
EXTENT OF MOUNTING ACTIVITY INDUCED BY INJECTIONS OF ANDROGENS ALONE, AND BY ESTROGENS IN COMBINATION WITH ANDROGENS, PROGESTERONE AND ADRENAL CORTICAL HORMONE

Hormones	Number of injected animals	Number in heat	Number of animals mounting
.25 mg. testosterone	2	0	0
.5 mg. testosterone	2	0	0
1.0 mg. testosterone	1	0	0
4×10 I.U. estrone+ .25 mg. testosterone	1	unknown	1
4×10 I.U. estrone+1.0 mg. testosterone	1	unknown	1
20+ 2×10 I.U. estrone+ .25 mg. testosterone	2	unknown	0
8×10 I.U. estrone+ .25 mg. testosterone benzoate	1	0	0
20+20+20+25 I.U. estrone+ .25 mg. testosterone	4	unknown	2
20+20+20+25 I.U. estrone+ .5 mg. testosterone	1	0	0
4×10 I.U. estradiol benzoate	1	1	0
4×10 I.U. estradiol benzoate+ .25 mg. androstenedione	2	1	0
4×10 I.U. estradiol benzoate+ .25 mg. androstenediol	3	0	0
4×10 I.U. estradiol benzoate+ .25 mg. dehydroandrosterone	2	0	0
4×10 I.U. estradiol benzoate+ .25 mg. dehydroandrosterone acetate	3	0	0
4×10 I.U. estradiol benzoate+ .25 mg. dehydroandrosterone acetate +0.2 I.U. progesterone	4	4	1
4×10 I.U. estradiol benzoate+ .25 mg. dehydroandrosterone+0.2 I.U. progesterone	1	1	1
4×10 I.U. estradiol benzoate+ .25 mg. androstenedione+0.2 I.U. progesterone	3	3	1
4×10 I.U. estradiol benzoate+ .25 mg. androstenediol +0.2 I.U. progesterone	2	2	1
4×10 I.U. estradiol benzoate+0.2 I.U. progesterone +1 cc. adrenal cortical hormone	4	4	2
4×10 I.U. estrone + .25 mg. testosterone +0.2 I.U. progesterone	1	1	1

when estrogens alone were injected. Furthermore, in no animal injected with 0.2 I.U. progesterone without a conditioning injection of estrogen was either heat or mounting induced.

A protocol from an experiment in

tivity, the promptness with which heat and mounting follow the injection of progesterone, and the close temporal relationship between heat and mounting are apparent.

The problem was approached in an-

other way. Twenty-seven animals confined in a single cage were injected with 50 I.U. estradiol benzoate. Forty-eight hours later 14, constituting a first group were injected with 0.1 I.U. progesterone and returned to the cage containing the other 13 which constituted the second group. All were then observed for mounting. Ten of the 14 injected with progesterone displayed vigorous mounting activity. None in the second group mounted. Twenty-four hours later, and therefore 72 hours after the condition-

by the synergistic action of estrogen and progesterone. The fact remained, however, that mounting activity is a male-like behavior and it became of interest to ascertain to what extent mounting is induced by the injection of androgens alone or androgens in combination with estrogens.

The procedures and results are summarized in *Table II*. No mounting followed the injection of androgen alone into five spayed animals. When androgens were preceded by conditioning

TABLE III

EFFECT OF A SINGLE INJECTION OF 50 I.U. ESTRADIOL BENZOATE FOLLOWED AT DIFFERENT INTERVALS BY 0.1 I.U. PROGESTERONE IN INDUCING HEAT AND MOUNTING ACTIVITY

Interval between injections	1 day	1½ days	2 days	3 days	4 days	5 days	6 days	7 days
Number of injected animals	51	37	75	93	76	46	51	48
Number in heat	34	37	68	67	51	8	6	4
Percentage in heat	67	100	90	72	62	17	12	8
Average latent period in hours	6.1	5.8	4.5	4.7	4.0	5.0	4.5	4.0
Average heat period in hours	5.1	5.2	5.2	5.0	4.8	5.3	4.5	4.8
Number of animals which completed attempts to mount	16	27	52	37	36	2	3	2
Percentage that mounted	31	73	69	40	45	4	6	4

ing injection of estradiol benzoate, the members of the second group received 0.1 I.U. progesterone and were returned to the cage containing the 14 injected the day before. Again, all were observed for mounting activity. This time the only mounting was displayed by 5 of the 13 in the second group. It is evident, therefore, that estrogen-conditioned animals were not stimulated to mount by the presence of animals which were mounting actively; any display of mounting in excess of the little mounting normally induced by estrogens depended on the injection of progesterone.

The data presented above were thought to provide a basis for the hypothesis that in the normal female mounting activity like heat is induced

injections of estrogens, mounting occurred in 4 of 20 injected animals. When estrogen, androgen and progesterone with or without the adrenal cortical hormone (Eschatin) were injected, mounting occurred in 5 of 11 animals. In none of these can the mounting be attributed with certainty to the injected androgens, for it may have been induced by the estrogens or progesterone. This suggestion is strengthened by data obtained as a by-product from a re-investigation of the effects of estrogen followed by certain androgens on the induction of heat. Although heat has thus far been induced in 56 per cent of 25 animals injected with estrogens and testosterone, no mounting has been observed (unpublished data, Fish and Young). For the present, therefore, it

must be concluded that the androgens which were used were not more effective than progesterone in inducing mounting activity.

We were next interested in ascertaining if the mounting activity of injected spayed animals simulates that of normal animals. In order to determine this, data from spayed animals injected with

identical with that displayed by normal animals.

Determination of a means whereby mounting activity can be induced has enabled us to obtain considerable miscellaneous information about it. We first ascertained the length of time animals injected with estrogen remain conditioned, a point which had previously been determined for heat (Collins, Boling, Dempsey and Young, 4). Animals were conditioned with 50 I.U. estradiol benzoate and then injected once with 0.1 I.U. progesterone. Eight groups composed of from 37 to 93 animals each were established, the progesterone being injected 1, 1½, 2, 3, 4, 5, 6 or 7 days after the conditioning injection of estrogen. After the progesterone had been given, the animals were observed continuously until heat and mounting activity were no longer being displayed. The data are summarized in Table III and Fig. 3.

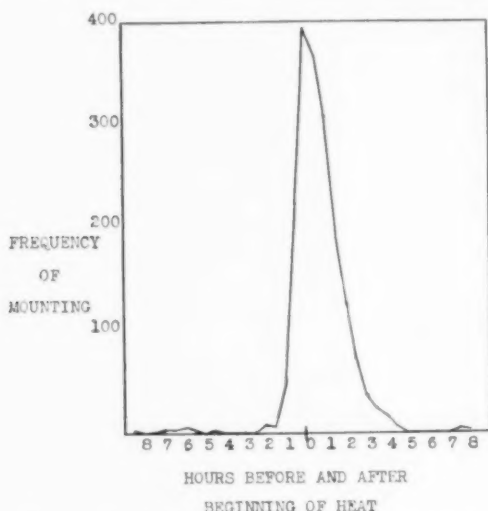


FIG. 2. Temporal relationship between mounting activity and heat in spayed animals injected with estrogen and progesterone.

estrogen and progesterone were compared with those from normal animals (Young, Dempsey, Hagquist and Boling, 16). In the normal group 91 per cent mounted, whereas in the experimental group in which the treatment was optimal 73 per cent mounted (Table III). In the normal group the peak of mounting coincided with the beginning of heat, and in the experimental group the peak of mounting also occurred at this time (Fig. 2). In both groups the overt form of the behavior was identical. With the exception, therefore, of what probably is an unimportant difference in the percentage of animals which mounted, the data are completely comparable and mounting activity induced in spayed animals by the injection of estrogen and progesterone is concluded to be

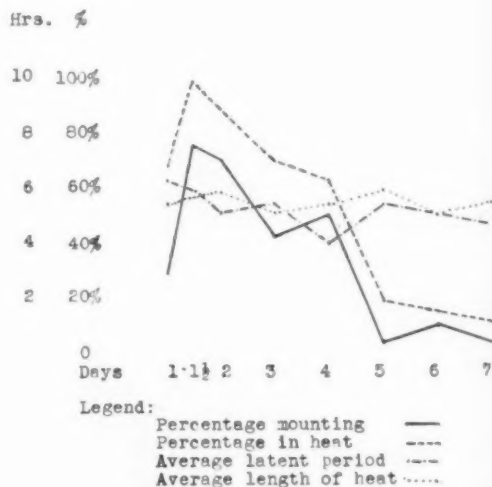


FIG. 3. Latent period and length of heat and percentage of injected spayed animals displaying heat and mounting activity following 50 I.U. estradiol benzoate and 0.1 I.U. progesterone.

The conclusion of Collins, Boling, Dempsey and Young that the length of the latent period and the length of heat following progesterone injection do not change during the period animals re-

TABLE IV  
NUMBER OF COMPLETED ATTEMPTS TO MOUNT DISPLAYED BY 31 SPAYED FEMALES RECEIVING FROM 4 TO 9 SERIES OF ESTROGEN-PROGESTERONE INJECTIONS

Hormones	4×12.5 I.U. estrone 0.1 I.U. progesterone		50 I.U. estradiol benzoate 0.1 I.U. progesterone										200 I.U. estradiol benzoate 0.1 I.U. progesterone		250 I.U. estradiol benzoate 0.3 I.U. progesterone	
Date of injection	2-2-38	2-26-38	10-6	10-24	11-7	11-21	12-5	1-12-39	1-13	1-28	2-13	4-17	4-29	1-28-39	3-1-39	
Number of animals																
4																
8		0		0	0	0	0	0	5			0	0	0	0	
22	0	0		0	0	0	0	0				5	1	0	0	
24		0			0	0	0	0				0		0	0	
28			2		0	0	1					0	3	0	0	
37					0	0	0	0						0	0	
39		0			0	0	0							0	24	
47	0				1	0	2							0	1	
49	1			3	1	2	1	4				5		1	0	
69						4	0	1				2		14	3	
77			0			0	0							14	4	
89			1	1	1	0	2					7	1	0	0	
9	10		14	4	8	6	3					9		4	2	
15		11							28	2						
21	12				41	22	45		12	3						
23		0		0	9	1	14		9				9			
33	2				9	0	25		8			24	23			
34	2			3	1	5	3					14	0			
36	1		9	3	13	6	5									
41	0			0	13	8	12									
42	11			20	28	23	13		28	34	30	4				
43	13					37	6									
44	23			1	4	16	14									
48		10														
65			21	12	24	10	35	21		4	12	11	0			
71						8	9	27								
73								11				53				
85			28	36												
91			37	30						36	46		25			
97			15	86						169	26		11			
99			8	9				15								



TABLE V  
NUMBER OF INJECTED SPAYED YOUNG ANIMALS AND INJECTED NORMAL SEXUALLY IMMATURE ANIMALS WHICH MOUNTED  
FOLLOWING INJECTIONS OF ESTROGEN AND PROGESTERONE

Number of injected animals	Age at time of injection											
	30 days		35 days		40 days		43 days		52 days		53 days	
	Number in heat	Number mounting	Number in heat	Number mounting	Number in heat	Number mounting	Number in heat	Number mounting	Number in heat	Number mounting	Number in heat	Number mounting
14 spayed at birth	13	0										
14 spayed at birth	14	0										
10 normal	10	0										
3 spayed at birth			2	0								
2 normal			2	0								
2 spayed at birth							2	0				
4 normal							3	0				
6 spayed 36th day					6	0					6	2
4 spayed 48th day									4	0		3

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main conditioned was confirmed. In the case of mounting, the only significant data concerned the percentage of animals which mounted and the length of time they remained conditioned. The highest percentage mounted when progesterone was injected  $1\frac{1}{2}$  days after the estrogen. Thereafter the percentage decreased until the 7th day when only 4 per cent mounted. In both respects the data are similar to those obtained for the heat response.

The extent to which mounting activity is displayed by normal animals varies from individual to individual, but tends to be relatively consistent from cycle to cycle in the same animal (Young, Dempsey and Myers, 12). Spayed animals are not different, for when injected repeatedly individual differences were shown. Over a period of more than a year 31 unselected spayed animals received from 2 to 7 injections of 50 I.U. estradiol benzoate or estrone followed by 0.1 I.U. progesterone. Twelve of these received two additional series of injections: a first of 200 I.U. estradiol benzoate followed by 0.1 I.U. progesterone, and a second of 250 I.U. estradiol benzoate followed by 0.3 I.U. progesterone. After the injections all were observed continuously for heat and mounting activity. The results are summarized in *Table IV* and reveal clearly the tendency for a particular type of response to be given repeatedly by individual animals, even though the quantity of injected hormone is increased.

When the factors involved in the stimulation of the heat response were being studied, it was found that 8 of 10 animals which had been ovulating regularly, but which had not come into heat, were brought into heat after ovariectomy by the injection of double the normally administered quantity of estrogen followed by progesterone (Boling, Young and Dempsey, 2). The

result suggested the possibility that mounting activity might also be stimulated in refractory animals by the injection of larger quantities of estrogen or progesterone. Consequently, 12 animals which had displayed little or no mounting activity following any one of 2 to 6 series of injections of 50 I.U. estradiol benzoate and 0.1 I.U. progesterone, were injected a first time with 200 I.U. estradiol benzoate followed 48 hours later by 0.1 I.U. progesterone, and a second time with 250 I.U. estradiol benzoate followed by 0.3 I.U. progesterone. Only 3 of the 24 injections were followed by a significant increase in mounting activity and in no instance was one animal stimulated to more than normal activity by both series of injections. It is concluded, therefore, that increased quantities of estrogen and progesterone in the dosages given are no more effective in inducing mounting activity than smaller quantities.

In the last part of the investigation an attempt was made to ascertain the age at which mounting activity can first be stimulated. Thus far relatively few experiments have been possible, but the data are of interest for comparison with what is known about the induction of heat in sexually immature animals.

A heat-like behavior is displayed by newborn animals and heat responses were induced in nine 20-day animals which had not previously been injected (Boling, Blandau, Wilson and Young, 3), but such animals did not mount. In this experiment 16 normal and 43 spayed animals, 30 to 52 days of age, which had not previously been injected received either 50 or 100 I.U. estradiol benzoate followed by 0.1 I.U. progesterone. Ten also received second injections when they were either 53 or 65 days old (*Table V*). Although 66 of the 69 injections were followed by heat (75



whereas not more than 90 per cent normal animals and 73 per cent injected spayed animals have been observed to mount. A final difference involves the response being shown to testosterone in experiments which are in progress. Animals which are being injected with this hormone following a conditioning injection of estrogen are coming into heat, but are not displaying any mounting activity.

Beyond this statement of the status of the investigation, little can be said except to cite problems which are in need of further study. An explanation should be found for the circumstance that mounting activity and heat are similar in some respects and different in others. The working hypothesis is advanced that the two parts of overt heat behavior are mediated by two effector systems composed of different central nervous mechanisms, one mediating the lordosis or opisthotonus given to tactile stimuli (Dempsey and Rioch, 5), and the other mediating mounting which frequently is spontaneous and which therefore appears to be displayed as a result of some internal stimulus. If two mechanisms do exist, both are stimulated by the synergistic action of estrogen and progesterone, but each has its own threshold which varies from animal to animal. Such a hypothetical explanation would account for the close temporal relationship between the heat response and mounting and for most, if not all, of the differences which have been found.

Several other problems are also in need of investigation: 1) The significance of the relationship between the extent of mounting and the number of maturing follicles is not known. 2) It should be determined if there is an increased spontaneous activity at heat which is different from that which naturally accompanies homosexual behavior. 3) Mounting activity occurs in

normal animals as early as the 33rd day. Therefore the cause of the failure to induce mounting in spayed animals prior to the 53rd day should be investigated. 4) An effort should be made to find an explanation for the refractoriness of animals which fail to respond, not only to quantities of the hormones ordinarily sufficient to induce mounting, but also to larger quantities. 5) The action of androgens should be investigated further. Early in the work it was anticipated that estrogen-androgen rather than estrogen-progesterone action would stimulate mounting activity. The relative ineffectiveness of the androgens which have been employed is surprising, but their ability to substitute for progesterone more efficiently in the induction of heat than in the induction of the male-like mounting activity is even more puzzling.

#### SUMMARY AND CONCLUSIONS

The induction of homosexual or mounting activity in spayed female guinea pigs was attempted by means of injections of estrogens alone, estrogens and progesterone, and androgens alone or in combination with estrogens and progesterone.

Estrogen followed by progesterone was more effective than any single hormone or any other combination of hormones. It is postulated, therefore, that these hormones acting synergistically are responsible for mounting activity as well as heat in the normal animal.

Estrogen-conditioned animals were not stimulated to mount by the presence of animals which were mounting actively; any display of mounting in excess of that normally induced by estrogens depended on the injection of progesterone.

The highest percentage of animals was induced to mount when progesterone was injected 36 hours after the conditioning injection of estrogen. A



diminishing percentage remained conditioned as long as seven days.

The extent to which mounting activity was displayed by injected spayed animals varied, but tended to be relatively constant in individuals given repeated series of injections.

Animals which were refractory to the quantity of hormones which induced mounting in most animals remained refractory when given increased dosages.

In spayed immature animals the heat response was induced at an earlier age than mounting activity.

The similarities and differences between mounting activity and the heat response are enumerated. They suggest the hypothesis that the two parts of overt sexual behavior are mediated by two effector systems; both are stimulated by the synergistic action of estrogen and progesterone, but each has its threshold which may vary from animal to animal.

#### ABSTRACT

The induction of homosexual activity in spayed female guinea pigs was attempted by means of injections of estrogens alone, estrogens and progesterone, and androgens alone or in combination with estrogens and progesterone.

Estrogen followed by progesterone was more effective than any single hormone or any other combination of hormones. It is postulated, therefore, that these hormones acting synergistically are responsible for mounting activity as well as heat in the normal animal.

Estrogen-conditioned animals were not stimulated to mount by animals which were mounting actively; any display of mounting in excess of that normally induced by estrogens depended on the injection of progesterone.

The highest percentage of animals was induced to mount when progesterone was injected 36 hours after the conditioning injection of estrogen. A diminishing percentage remained conditioned as long as seven days.

The extent to which mounting activity was displayed varied, but tended to be relatively consistent in individuals given repeated series of injections.

Animals which were refractory to the quantity of hormones which induced mounting in most animals remained refractory when given increased dosages.

In spayed immature animals the heat response was induced at an earlier age than mounting activity.

The similarities and differences between mounting

activity and the heat response are enumerated. They suggest the working hypothesis that the two parts of overt behavior are mediated by two effector systems, that both are stimulated by the synergistic action of estrogen and progesterone, but that each has its threshold which varies independently from animal to animal.

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## THE CORRELATIONS BETWEEN OVARIAN ACTIVITY AND PSYCHODYNAMIC PROCESSES: II. THE MENSTRUAL PHASE\*

THERESE BENEDEK, M.D., AND BORIS B. RUBENSTEIN, M.D., Ph.D.\*\*

IN THE FIRST PART of this communication (Psychosom. Med., 1: 245-270, 1939) we presented evidence indicating that human instinctual drives are controlled by gonadal hormone production. This had already been recognized in birds and lower mammals (10). Inasmuch as human instinctual drives are overtly expressed only in specific situations, it was necessary to infer their presence by study of dreams and phantasies, of free associations, and of all other types of psychological material. Analysis of psychoanalytic records provided a method of inference of the minute changes in the instinctual drives. Day-by-day study of vaginal smears and basal body temperature was the method of determining levels of ovarian function and ovulation time. The endocrine and psychoanalytic records were independently organized, evaluated, and then compared. Thus correlations in the psychological and physiological processes on each day of the cycle were found.

The conclusions of Part I of this paper were: *First: a) whenever heterosexual drive, either as desire or as defense against it, appeared in the psychoanalytic material, estrone was produced in quantities sufficient to be recognized in the vaginal smear. b) Whenever the erotization of the female body markedly dom-*

*inated the psychoanalytic material, progesterone activity was found in the vaginal smears.* Progesterone production was further correlated with a passive receptive instinctual tendency which might be expressed on the genital level as a wish for impregnation, as contrasted to the desire for coitus or on the pre-genital level as a tendency toward being generally receptive and dependent.

*Second: The psychic apparatus recorded incipient production of these hormones with extreme sensitivity.* The change in direction of the instinctual tendencies from the active object-directed psychic energy to the passive inwardly directed instinctual tendencies represented a qualitative change in the cycle. This qualitative change produces the psychological cycle with the same regularity as progesterone—the antagonist of estrone produces the hormonal cycle.

*Third: An abrupt decrease in heterosexual tension together with an influx of passive libido tendencies—narcissistic erotization—characterized ovulation as determined by the vaginal smear-basal body temperature technique.*

In our report on the ovulative phase of the menstrual cycle we had centered our attention on ovulation. We described the hormonal changes of this phase.

Our present report concerning the premenstrual-menstrual phase of the cycle centers about the hormonal factors which precipitate the menstrual flow. Unlike the preovulative-ovula-

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\*\* From the Institute for Psychoanalysis, Chicago, Illinois and the Brush Foundation and Department of Gynecology, Western Reserve University. Dr. Rubenstein is a Fellow of the Rockefeller Foundation.

tive phase of the cycle which was characterized by intense and growing gonadal activity, the present report deals with the phase of diminishing and low gonad function. The premenstrual phase is characteristically the phase of regressing corpus luteum function and consequently of diminishing progesterone production. Estrone production during the premenstrual phase is variable. At first it diminishes together with the progesterone since both hormones are produced in lessening amounts by the regressing corpus luteum. Later, estrone production may increase if new follicles begin development. In general, estrone production fluctuates irregularly, but at a low level since proliferation of the vaginal mucosa is rarely sufficiently stimulated to result in complete cornification of the superficial layers (the cells of which are seen in the vaginal smears). It is worthwhile reiterating that no direct measurements of either estrone or progesterone have been made on any of these patients whose cycles are presented in this paper. Changes in level of production are inferred from the changes in the basal body temperatures and the vaginal smears. At no time is an absolute measure of estrone or progesterone production presented. Indeed such an estimate is impractical for reasons which have been presented in some detail in Part I of this publication.

The variability of the premenstrual phase, of course, had been predicted on the basis of clinical knowledge; and it had been known that the onset of flow could be delayed by many circumstances—fear of pregnancy especially in unmarried women, a long journey, change of climate, the shock of a death. The onset of flow may also be delayed by hormonal change: by use of either male hormone or progesterone. Conversely, menstruation may be precipitated by an equal variety of

emotional shocks, by physical injuries to the uterus or ovaries or by the withdrawal of hormone from women who had been receiving it. The older literature is replete with theories concerning the mechanism of onset of menstruation. The literature is well summarized by Allen et al. (1). Inasmuch as in most women a corpus luteum is formed after ovulation, the progesterone deprivation theory for menstruation probably comes closest to the mark (4, 6, 11). For experimental purposes it is, of course, possible to simplify the hormone situation. In castrate women the injection of progressively increasing doses of estrone followed by the injection of estrone plus progesterone combinations yields a typical uterine development. Upon cessation of treatment, menstrual flow occurs (7, 11). It has, of course, been recognized that the menstrual flow may be precipitated or suppressed at least for a time in both acute and chronic emotional states. The hypothetical mechanism of the precipitation or suppression is probably through hypothalamic autonomic centers. This suggests that menstruation involves neural as well as endocrine mechanisms (8, 9).

The premenstrual phase is characterized by an unmasking of estrone activity and the development of new follicles which may or may not mature. The unmasking of estrone implies a regression in progesterone production and in corpus luteum activity.

Usually the peak of progesterone production occurs two to ten days before the onset of flow. After the peak there is a more or less rapid regression in corpus luteum function which is reflected in the vaginal smears by a reduction in desquamation, the appearance of degenerated cells and cell debris, and the reappearance of leukocytes, bacteria, and mucus. About the same time a new follicle or crop of

follicles destined not to mature ordinarily begins its development. As the progesterone production of the regressing corpus luteum diminishes nearly to the vanishing point, the estrone produced by the newly developing follicle is unmasked. Its effects may be recognized by 1) a decline in basal body temperature and 2) the reappearance of cornifying and cornified cells in the vaginal smears. Usually these follicles regress, others appear and regress, none even approaches mature development in the premenstrual phase. The smears therefore show the occasional scattered appearance of cornified cells and more usually degenerated cells, cell debris and vaginal secretions. The basal body temperatures fluctuate irregularly but usually on a declining curve. The period is characterized by variably shifting and generally low hormone production.

The onset of flow, heralded by the appearance of increasing numbers of red blood cells and leukocytes, might therefore be called a hormone withdrawal symptom. The onset of flow itself does not necessarily occur at a characteristic estrone level even in successive cycles of the same woman. It does occur after progesterone production is nearly extinguished. There may still be traces of progesterone activity at the time of onset of flow. During the period of flow, new follicles may develop. Luteinization of immature follicles may also occur. Thus the only endocrine characteristic of the premenstrual-menstrual phase of the cycle is a diminishing progesterone level.

We have observed a few cycles in which the premenstrual phase was a phase with maintained progesterone production. In these cycles the temperatures remained high and the vaginal smears showed marked desquamation and aggregation of cells and abundant secretion throughout the

period. The menstrual flow was not heralded by any microscopically observable signs. This type of menstrual flow is comparable to the type observed in experimental animals from whom progesterone is suddenly withdrawn. Another type of premenstrual development is the following: Upon regression of the corpus luteum a follicle begins to mature and goes on developing without regression. There is an increasing estrone production during this phase of the cycle and no progesterone. In these cycles the premenstrual phase cannot be distinguished from the early pre-ovulative phase. These patients usually have dysmenorrhoea.

The type of menstruation which is purely estrone-deprivation bleeding is uncommon in adult women. We have one patient with infantile genitalia who has not ovulated during the period of observation. She has no corpus luteum phase during her cycle, her cycle is irregular and her bleeding scanty. Hers is probably estrone-privea menstruation and may be common in adolescence.

In our present report we shall attempt to present the correlations between various premenstrual-menstrual hormonal states and their psychodynamics.

Our present knowledge permits us to recognize the qualitative changes in gonad hormone production by interpretation of the psychoanalytic material. We correlated the specific hormonal functions of the ovary with specific instinctual drives: estrone production with heterosexual drive, progesterone production with passive receptive instinctual tendencies. We have also stated that during the ovulative phase there is a semi-quantitative relation between the level of hormone production and the dynamic intensity of its psychic concomitants. We are

well aware of the difficulties in attempting quantitative evaluation of psychological material. The factors and motives determining the psychic reactions of an individual to her hormones are so complex that even an approximately quantitative evaluation is impossible without a knowledge of personality structure through which the psychodynamic state is evaluated and its changes estimated day-by-day.<sup>1</sup>

Despite the restrictions imposed by methodologic inadequacy we were prompted to make quantitative estimates of the intensity of the instinctual drives on the basis of their emotional manifestations. Remembering the approximate character of these estimates, we submit some of the technique utilized in the quantitative evaluation. The most successful method of quantitative estimation is the "measuring" of the defense reaction employed to combat an instinctual drive. Thus it is easiest to make quantitative comparisons in neurotic women whose inhibited and dammed-up instinctual drives call for strong defense reactions. For example we presented the ovulative phase of G. S. December 10-26, 1937 (pp. 255-258) and January 15-30 (pp. 258-261)<sup>2</sup> in which the "noisy" masculine protest and gradually increasing aggression permit a semi-quantitative evaluation of the growing heterosexual tension. Anxiety, as the other main reaction against heterosexual drive, also permits quantitative evaluation. (See R. E. November 13-14, pp. 248-249. Table II).<sup>3</sup> It is more difficult to evaluate the positive manifestations of heterosexual desire. In some cases

heterosexual phantasies flourish. The corresponding hormone level is sometimes quite high, sometimes low. We often find that phantasies on the pre-genital level correspond with low hormone production. In other cases heterosexual desire is expressed with great apprehension which would indicate great hormonal tension, but closer investigation shows that the physiological need is not great; the apprehension expresses the psychological need of the infantile, demanding Ego to secure immediate gratification.

The change in personality and in psychodynamics which is the goal of psychoanalytic treatment is an important source of error in our evaluation. The patient whose reaction to her estrone we found to be an aggressive defense and hateful protest may later react to the same hormone level with less psychic tension. She may yield to phantasies not permitted before; or she may find real gratification which changes her psychological reactions.

The instinctual desires of normal adult women are more readily gratified. Therefore they are little dependent upon dreams and phantasies. The ovulative phase in such women is psychologically not so obvious as in our case material of neurotic women.

The estimation of emotional intensity is however a macroscopic method. There is another evidence of quantitative change in hormone production which we term microscopic. This is the estimation of libido level. It seems that psychoanalytic material on the "genital level", in dreams, as well as conscious genital desire, capability for orgasm etc., corresponds with higher hormone production, than psychoanalytic material on the "pre-genital level". This "microscopic" differentiation is important for the estimation of hormone fluctuation in those phases in which the estrone level is lower and

<sup>1</sup> The microscopic dream studies of Thomas M. French, M.D., promise a precise method of measurement of instinctual changes.

<sup>2</sup> Benedek, Therese and Rubenstein, Boris B.: The correlations between ovarian activity and psychodynamic processes: I. The Ovulation Phase, *Psychosom. Med.* 7: pages cited, 1939.

<sup>3</sup> Cf. Fn. 2., above.



the instinctual drive is less clearly manifested in the conscious emotional state. This aspect of evaluation is also important for estimation of progesterone activity. During the luteal phase the emotional tension is usually not so great as during the preovulatory phase. Increasing progesterone manifests itself in the growing clarity of the emotional attitude toward impregnation, pregnancy and child. The receptive instinctual tendencies expressed on the genital level, either as wish for impregnation and pregnancy or as defense against it, still reflect a rather high progesterone function. Simultaneously there is an increasing preoccupation with the emotional relationship toward child or mother. If the personality development involves an intense conflict concerning the mother, great ambivalence toward her pregnancies, then progesterone function may be estimated by the intensity with which this conflict appears in the psychoanalytic material. This "pregnancy material" expresses conflict on the "genital level". When progesterone production does not develop to so high a degree, we miss "pregnancy material". The passive, oral-dependent pregenital-receptive material of adult women corresponds to a lower level of progesterone activity. During the premenstrual and menstrual phase we observed regression to the anal level in the psychoanalytic material which could be related to regression in progesterone production. Progesterone regression which necessarily precedes the onset of menstrual flow is correlated with eliminative tendencies. These may appear in the psychoanalytic material as anal or urinary regression (soiling tendency); often the eliminating tendencies remain on the genital level as birth, abortion or castration phantasies.

In the premenstrual-menstrual phase of the cycle, quantitative estimation of

the instinctual drives is prone to error because hormone levels are low and the instinctual tendencies which the hormones control are not clearly manifested in the psychological material. But utilizing the knowledge gained by our analysis of the much clearer preovulatory-ovulatory phase of the cycle, we were able to interpret the analytic material in relation to the fluctuations of the ovarian hormones and predict the vaginal smear interpretation. Qualitative determination of estrone and progesterone activity could invariably be correlated with the psychodynamic material. We could also recognize the regression of the hormone function.

There were no discrepancies in our correlations between hormone production and instinctual drives when the hormone levels were high. In the late premenstrual phase, despite low hormone levels, the emotional state can nevertheless be tense and acute, as if hormone levels were high. The emotional state before the onset of menstrual flow is influenced by various factors. Its complexity and acuteness cannot always be explained on the basis of the related hormonal state.

Sociological factors are extremely important in the adaptation to the biological task of women. The interplay of sociological, psychological, and biological factors as they manifest themselves in the psychology of menstruation is not in the scope of this paper.

#### DATA AND DISCUSSION

The material of this paper was selected from a total of 125 cycles of 15 patients. The selection, as before, was guided by the necessity for brevity and clarity of the psychological material.

We recognize the necessity for knowledge of the individual and her psychodynamic structure for the evaluation of her psychoanalytic records. But in



this presentation we must omit any extensive description of the individual cases. We also omit publication of association material which would distract attention from the instinctual tendencies expressed in the deep layer of the dream and direct attention to the actual problems of the patient, knowledge of which is unnecessary for an understanding of our general thesis. We selected those data in which the underlying instinctual tendencies are expressed at a manifest level in the dream. When this was impossible, we presented only the interpretation of the dreams or other pertinent psychological data. The interpretations which appear in the psychoanalytic records and the hormone predictions made on the basis of the dreams are presented and compared with the independently evaluated vaginal smear-basal body temperature records.

*A. First Premenstrual Evidence:* Progesterone dominance develops after ovulation has occurred, but persists only a few days unless pregnancy intervenes. After the peak of corpus luteum function, regression begins, and the production of progesterone diminishes. Many new follicles begin their development. Ordinarily none of these follicles matures. However, estrone is produced in small quantities. "The first evidence of premenstrual change" is the consequence of this unmasking of estrone. This is seen in the smears as minimal cornification after a period during which cornification was absent. In the basal temperatures the estrone influx produces a gradual decline. The psychological material reflects the change in hormone status by the appearance of heterosexual tendencies. In Part I of this paper we published some examples of this earliest premenstrual change (V.M. 12-8-37 and V. M. 5-25-38, pp. 266-267),<sup>4</sup> where the het-

erosexual tendency was clear enough to be recognized. The same patient V. M. in the cycle 10/25 to 11/18, on 11/9 had the following dream:

*DREAM:* I was roller skating down a highway. I wanted to be sure of myself. I went very fast. People became small, the road became rough. I was insecure. I went between different people. The road went under a ledge. We were examining it to see if it was safe enough. Some female person was with me. We went into a little building like a depot. A young man was waiting for me. I had a disagreement with him because I refused to go to his home. It was engineered for us to be together. I was in love with him. I went to his bedroom. I saw his mother. She was Italian. I was wondering how I would get along with her.

In this dream we see the wish to free herself from her home and become independent. The wish for independence conflicted with the fear of being abandoned to her own sexual wishes. The world is full of sexual dangers and so a protective woman appeared in the dream. Only under the guard of this "female person" did she permit herself to express the sexual temptation. But the heterosexual wish also threatened her independence. The mother figure reappeared, now not as protecting her from danger, but interfering with her sexual wishes. The need for sheltered dependency was expressed by ambivalence toward the mother. The mother was at once the protective and prohibitive person. The heterosexual wish was strong enough to appear in the dream as an illusion of love, and sexual desire, but on the whole in this dream the conflict with the mother was more important: it overcame the sexual wish. The dream ended with her wondering how she would get along with the mother. The tendencies ascribed to progesterone activity appeared stronger than the heterosexual desire.

<sup>4</sup> Cf. fn. 2, p. 464.

Therefore the prediction was: mainly progesterone but slight estrone tendencies, very early premenstrual.

*Vaginal smear 11/9/37:* Few degenerated cells, aggregated. Occasional cornified cell. Very early premenstrual.

Another patient, P. O., had a very long lutein phase from 4/27 until 5/2. During this time her oral dependent attitude was acted out by overeating. The mother-conflict and wish to identify with the baby brother were central in the psychoanalytic material; her oral demanding and receptive attitude toward the analyst (female) showed the same material in transference. The following dream on 5/3 introduced the premenstrual phase.

*DREAM:* I was in a hotel lobby, great many people, many of them I knew. I was concerned because I was running short of funds. But I thought I could borrow. Some sort of convention. There was a woman there. I worked with her years ago. I kept thinking whether or not I should go to her and talk—finally I did. Then we were in a crowded train, I had difficulties because I had a lot of luggage. It was like Germany. Soldiers got into the train. A soldier sat beside me. He had a dog which took a great deal of the room. A porter took away my luggage.

The first part of the dream showed the continuation of the demanding and dependent attitude. But the crowded train, the closeness of the soldier, the symbolic meaning of the dog (penis), showed the first appearance of the heterosexual tendency.

*Vaginal smear 5/3/38:* First reappearance of cornified cells, but still moderate aggregation. Premenstrual.

Both examples show the instinctual tendencies characteristic for progesterone function. The heterosexual tendency appears beside the progesterone material. But not all "first premenstrual evidence" has this character.

There are cycles in which the lutein phase had not been very well developed; others, in which the progesterone function diminished before the heterosexual-tendency became obvious again in the psychoanalytic material. There are still other cycles in which the reaction to the slightest heterosexual tendency was so strong an emotional defense, that it overshadowed the progesterone tendencies of the material. For example, patient R. E. had the following dream on 12/1/37:

*DREAM:* . . . One thing that does stand out is, that the man doing the shooting had a gun in his hand and was in the basement. I don't know whether I was brave or what it was, but I was on the outside, I leaned over and put my hand in through the window and his long fingernails scratched my hand on the back near the thumb—there was blood coming out. It was a long scratch. His fingernails seemed to be so sharp that I seemed to feel it in my dream. This man was a thief and a murderer and he had a gun in his hand. Then there were a bunch of police and people running around. Then all of a sudden the lights went out and it was pitch dark.

This dream reflected mainly heterosexual tendencies. The desire for heterosexual attack, and the fear of pain connected with it were so clearly expressed in the dream that we might have predicted a high degree of estrone function. It was clearly premenstrual; but the estrone function was low. Quantitative comparison of the libido tendencies could not be made successfully.

*Vaginal smear 12/1/37:* Further degeneration of cells. More mucus and debris. Occasional cornified cell. Early premenstrual.

The following dream of another patient, F. F., is similar. On 11/9/38 she dreamed:

*DREAM:* I went up a long flight of dark stairs to an apartment where I was married to a colored man and had a little girl who was white. I went there to talk to him about something, perhaps about telling people that he and I married. Must have been for some time because the little girl was three to four years old. Some argument with a fat colored woman or someone else. I phoned the police and when the police came he was not there. He had slit my throat and I lay in a sack and he had thrown me downstairs in someone's living room or apartment, and then I yelled with the slit throat, croaking out to the police as he went out, that he had killed me. He ran out into a field, police after him and I thought, even though I was dead, he would be punished and I would haunt him.

This was her first premenstrual evidence. A slight influx of estrone production manifested itself in a dream which showed the most masochistic expectations connected with heterosexual gratification. The closer knowledge of this patient who is 28 years old, unmarried, sexually infantile—reveals that she repeated her infantile concept of sexuality which she acquired by experiences when she was three to four years old; like the little girl in the dream. The emotional intensity of the nightmare from which she awoke with a headache, can easily mislead us to assume that great heterosexual libido caused the anxiety. But this was not the case. Her emotional reaction to the heterosexual tendency was extremely strong. She reacted with a repetition of her infantile trauma and anxiety to even a slight heterosexual tension.

*Vaginal smear 11/9/38:* Leukocytic invasion and abundant mucus. Reappearance of many cornified cells (10 per cent). First premenstrual evidence.

These examples suffice to demonstrate that the reappearance of estrone function is immediately reflected in the psychological material. The change in

direction of the psychodynamic tendencies after a well developed lutein phase is as clearly marked as the change during the preovulative phase, when the first signs of progesterone function reversed the direction of the psychic tendencies. In the incipient premenstrual phase, we can rely with equal certainty on the qualitative change in the psychodynamic material. We never miss the reappearance of the instinctual trend, which is new to the specific phase of the cycle. But, as our examples show, quantitative evaluation of these instinctual trends depend on many factors: chiefly, on the individual's psychodynamic structure and personality development.

*B. The Premenstrual Phase:* After the easily identified reappearance of heterosexual material corresponding to new estrone activity, the premenstrual phase is characterized by variably shifting, but generally low hormone production. The normally decreasing progesterone activity and the low but variable estrone production cause a similar fluctuation in the psychoanalytic material. Where we found heterosexual and active object-libido, we predicted the existence of estrone function. The dependent passive libidinous tendencies, the wish for impregnation and pregnancy, the active and passive feeding tendencies we related to progesterone. It is worth noting that when, as is common in this phase of the cycle, hormone production is not so great as in the preovulative phase, the psychoanalytic material usually appears less charged with energy. The conflicts are not so sharply defined. The records leave the impression that the patient had a freer choice of material, and of its elaboration. For example in cases where the mother conflict is central, it will be worked through in this phase, even though the progesterone function diminished—because the intensity of

the estrone does not force the patient's thoughts and wishes in another direction. In other cases, when the patients' fear of the heterosexual tendencies is great—e.g. case R. E. 12/1 (467), case F. F. 11/9 (467), slight estrone production caused very intense defense reactions; it forced the patient to elaborate her heterosexual conflict material, to abandon or suppress the problems corresponding to the lutein phase. Thus our observations show that when hormone production is low, the problems and conflicts of the individual cover over the underlying instinctual tendency.

We selected cycles to demonstrate the varieties of premenstrual hormone states. We propose to show that a detailed analysis of the recorded psychoanalytic material enabled us to recognize the various premenstrual types. Analysis of the conscious emotional state, as expressed in attitudes and symptoms did not permit such a diagnosis.

G. S. premenstrual phase from 11/6 to 11/14/37. 11/6—Dream interpretation: child interferes with her narcissistic tendencies, therefore defensive and negativistic toward the child.

*Vaginal smear 11/6/37:* Regression in aggregation, earliest evidence of cornification.

Since the heterosexual references in the dream are vague, there were no psychological signs of the premenstrual estrone output. On 11/7, however, she reported a fragment of a dream of the night before:

"I found myself on what appeared to be the ground floor, out in the open, exposed to the view of the numerous people present. Dr. X. was on the ground with me. He was fondling my breasts and touching my sides with his hands. I responded to him with a strong sex urge but warned him that I would tell you everything and would report to you what he did.

"He appeared gay, free, and relaxed and while nodding approvingly at what I said, paid little attention to it, but kept on doing what he had before and talking really to the various people.

"I then went in a hallway. At the top of the stairs I saw two women whom I knew. They had evidently sought protection from danger but weren't then greatly alarmed. Suddenly my sister K., my husband, R., and her husband appeared. R., with real emotion but with some exaggeration in her presentation, said: 'Do you know what has happened to us?'

"I had rushed forth joyously to greet my husband, but became stricken with fear as I listened to R. I knew my husband would not have left Carl (her child) behind him unless something had happened to him. I called out in a frenzy of fear, 'Carl.'"

The strong heterosexual urge needs no further interpretation. The ambivalent attitude toward the child and the appearance of the two sisters—homosexual element and the need for protection, represent the "lutein material".

*Vaginal smear 11/7:* still considerable aggregation indicating lutein activity. The smear is definitely premenstrual. The amount of cornification is increased by comparison with that of the previous day.

11/8: The dream showed further increase of sexual urge; and during the analytical hour she gave associations referring to her pregnancy: "I had a need to kill myself when I was pregnant", indicating increasing aggression toward her pregnancy and herself. We have cited very similar material for this patient's preovulatory tension. The latter part of the premenstrual period started out with this aggressively colored dream.

*Vaginal smear 11/8:* essentially like that on 11/7.

On 11/9 she felt very apprehensive, had accelerated breathing, and fear of insanity.



*DREAM:* I was in a nightgown. My older sister K. came in. I was angry that she came in so late. I knew that she was with a man, having a good time. I realized I was jealous. I wanted to have the same. A little boy came in: something about a legal book.

Prediction: increasing estrone but some progesterone still present.

*Vaginal smear 11/9:* Clearly premenstrual, increasing cornification.

*No analytic material 11/10.*

*Vaginal smear 11/10:* clearly premenstrual; increasing cornification.

11/11: *DREAM:* You (woman analyst) were in a car driving away with a man. I told you: "Something is wrong with my son's sex organ". You said: "Oi Veh". I thought: "You are just a sentimental Jewish woman".

The association material during the analytic hour may be interpreted as a wish to bite off the penis of her son, showed oral incorporative tendency—aggression toward penis.

After the hour she developed abdominal cramps, diarrhoea.

*Vaginal smear 11/11:* premenstrual, many blood cells.

On 11/12 she had diarrhoea. She was resentful toward the analyst; this increased to conscious hatred and aggression. She identified herself with children who are badly treated and need to be protected.

*Vaginal smear 11/12:* practically no lutein activity. Smear showed red blood cells, leukocytes, marked cornification and mucus output.

On 11/13: increased aggression, tenseness. Extremely resentful because she is not loved. Necrophage fantasies, directed against (son's) penis.

*Vaginal smear 11/13:* Increased cornification.

11/14: *Dream content:* Longing for

home. Regressive tendency: longing for mother's womb. During the analytic hour: fear and defense against passive dependent tendencies. Diminished emotional tension.\*

*Vaginal smear 11/14:* Late premenstrual, increased secretion, degeneration. Low hormone level.

Menstrual flow started on November 14.

It was characteristic of this premenstrual state that the progesterone function was maintained until 11/12–11/13 although there was an increasing estrone production. Then progesterone disappeared while the estrone remained quite high. 11/13–11/14 the hormone production diminished just before the flow started.

The following cycle 12/10–1/8 of the same patient, G. S., is very instructive. We published the psychoanalytic material of the preovulative-ovulative and luteal phase from 12/14–12/26 (pp. 255–258).<sup>5</sup> The first premenstrual evidence occurred on 12/26. In the vaginal smear there was evidence of varying progesterone function with slight estrone production. This lasted until 1/3 but was accompanied by an increasing emotional tension. She felt "hypersexual." Neither phantasy nor coitus brought her relief. She described her condition on 1/3:

"I had a great desire to avoid people. I felt inadequate. I did not have any itching, until I came here. During most of the time (Christmas vacation) I was depressed. I wanted to come here. Yesterday I thought I did not care to see you. I had a lot of gas in myself. Terrific pressure. I disliked the idea of coming here. I became conscious of

\* The distinction between the psychological content corresponding to progesterone production and to regression in the hormone production needs further elaboration. Here we only refer to the fact that "dependency" is characteristic of an infantile emotional and libidinous state; thus in adults it corresponds to a regression.

<sup>5</sup> Cf. fn. 2, p. 464.



my weight. My body is enormous. This is always connected with distention of my abdomen.

"Last night I dreamt: I weighed 200 pounds. This woman was in an insane asylum. She could come and go at her will. Everybody laughed at her and had a good time at her expense. Somebody talked about syphilis. She assumed everybody gave her syphilis. But the woman at the desk told her she gave syphilis to everybody. All men died."

This dream showed her fear of being insane, and expressed her guilt and fear. It showed self-consciousness which is the negative aspect of her narcissism, so freely expressed in the postovulatory phase of the same cycle. It showed her fear of punishment because of her sexuality, and her revenge against men. On this basis the prediction was made: estrone and progesterone material.

*Vaginal smear 1/3:* More normal cells.

Minimal aggregation. Traces of cornification.

On 1/4 a skin rash developed. She felt slowed down, dull. It was difficult for her to breathe.

*DREAM:* You (female analyst) were coming toward me very smilingly. You had a tray in the hand, food on it. You said "Here is something to eat".

The dream showed the oral-need, and her dependence on the analyst. At the end of the hour the patient had a weeping spell and headache. The dream material corresponded to progesterone function.

*Vaginal smear 1/4:* More aggregation. 25 per cent cornification. Late premenstrual.

1/5: No analytic hour.

*Vaginal smear 1/5:* More debris but also more cornification (50 per cent).

1/6: She was depressed, but relieved by crying. During the analytic hour she repeated a dream, dreamed on 12/24

(and published as a characteristic womb dream in the postovulatory phase, p. 264).<sup>6</sup> She now associated her own birth with this dream.

"I was dead when I was born. The doctor put me in hot water. This is what my mother told me".

The birth material is associated with her own experience of labor. She said that today she had an impulse to steal. Prediction: Regressive progesterone.

*Vaginal smear 1/6:* More secretion. Still 50 per cent cornification.

1/7: After the last analytic hour she felt alert. The analytic material of this hour is presented in some detail. She began by complaining about a loose stool just before the session started. She said:

"My father forced me to take castor oil. I bit his finger. Once, when I was pregnant I took castor oil with orange juice. Since then orange juice often tasted like castor oil. This morning my orange juice produced the same sensation. Then I had the loose bowel movement. I thought 'to move my bowels.'"

Then the patient repeated her experience of labor.

"Terrific pain. I thought: 'How is it possible for people to let you suffer like that?' 'I will throw myself out of the window'. I was desperate. I was afraid I will have a bowel movement. The bearing down pains caused the feeling. I found it terrible. I did not want to do it. (Analyst moved in the chair.) Are you moving? I am afraid. I don't know what you will do to me. I dreamt about an old woman; she drew a big knife—I ran away".

*Vaginal smear 1/7:* Increased cornification (60 per cent). Slight aggregation.

This material highly charged with emotions is worth analysis for many reasons. We can easily recognize the fear of being destroyed. In the dream it was expressed by the fear of being cas-

<sup>6</sup> Cf. fn. 2, p. 464.

trated by a woman, and by the vivid recollection of the labor pains and by the loose bowel movement. The birth material related to progesterone function—the passive castration dream to estrone function. Thus, the psychological concomitants of both hormones were present: the “birth material” and the anal material were unusually charged with emotion. There was a fear of annihilation connected with this feeling of being abandoned to pain. The bowel movement and labor cause expulsion of all the body contents. The instinctual tendency to discharge was strong enough to cause anxiety comparable to the anxiety which accompanied her preovulatory aggression. The discharging tendency is typical of the late premenstrual phase and is evidence of progesterone regression. In this case the tendency to discharge is expressed on both the genital and anal level. The strong self-destructive tendency is an evidence of frustration of her genital discharge. This can be compared with the preovulatory phase in which the same conflicting tendencies were found, except that the aggression is turned toward herself. The premenstrual emotional tension is created by high estrone production, together with minimal progesterone production, just as in the preovulatory phase. The menstrual flow started on 1/8, suddenly like an abortion:

“I had a pressure, I had to move my bowels”. The flow was immediately very excessive.

The next cycle of the same patient, 1/8–2/4, had a quite different premenstrual phase. We published the ovulatory phase of this cycle 1/18–2/4, G. S. (pp. 258–261).<sup>7</sup> The premenstrual change occurred on 1/29, when she had the following dream:

“I was dreaming of going in my sister’s

house. There appeared to be some joke attached to it. When I awoke I thought in rapid succession of the two jolly young men whom I had liked in the woods”.

This dream showed incipient estrone activity. The conscious emotions and the psychoanalytic material still showed hostility toward mother and siblings. Thus the prediction was made: progesterone material and incipient estrone—premenstrual evidence.

*Vaginal smear 1/29:* Mostly normal cells, few cornified cells. Premenstrual.

On 1/30, she felt hostile, depressed and still disliked. She felt enormous. The dream showed ambivalence toward her son.

*Vaginal smear 1/30:* Mostly normal cells, few folded, few cornified. Very early premenstrual.

On 1/31: *DREAM:* My sister K. was leaving town to meet a married man. I was concerned, because I heard that the wife of this man hired detectives. I went to her, I found her in bed, which was in an enormous room. It reminded me of a barn, where something sexual happened in my childhood.

Suddenly there appeared a group of people who have their meetings there. We called the registry of the hotel about this intrusion but they said—“that is all right” and we have to accept this situation. Then it was on the street. I observe men—try to find out which is the detective. Then K. was going to Detroit to get married.

The association material for this dream is very abundant. The main factors in the dream are: 1) Fear of the mother who will punish her for her sex life. 2) The heterosexual tendencies. 3) Her defense against the men intruding which is not so aggressive as usual. The fear of being observed and the need to observe are connected with self-defense and fear of punishment. The analytic hour showed various regressions.

<sup>7</sup> Cf. fn. 2, p. 464.

She told of soiling herself; about the odor of her mother's body—"I am thinking about the periodic changes which my body undergoes. My breasts enlarged, I look enormous, I prefer black at such times; all the sensations of my body are so disgusting, so ugly".

Before the hour she showed a regressive tendency and self-consciousness about the body which is related to anal material. Prediction: Regressive progesterone and not too high estrone.

*Vaginal smear 1/31:* More cells with pyknotic nuclei. Slight increase in cornification. No aggregation.

2/1: She looked stubborn and depressed. The main topics of the analytic hour were her defense against her need to be dependent and the problem of toilet-training of her child and of herself. She was depressed, with great infantile dependency, identification with baby. On the basis of the anal material which we considered regressive, decreasing hormone production was predicted.

*Vaginal smear 2/1:* Essentially the same as on 1/31. No folding—very little cornification. Low hormone level. Low hormone production characterized this cycle until the onset of the flow.

On 2/2 she felt better. Nevertheless her relationship and emotional reaction to her sister's child were upsetting. "I was afraid to carry the baby, though I felt very tender toward it". This is a typical progesterone reaction, *viz.* yearning for the child—which is usual in the premenstrual phase.

*Vaginal smear 2/2:* More debris. Low hormone level.

2/3: Feels like crying. Tearful. She feels she ought to be punished for something. She starts by talking about her spite reactions and temper tantrums toward her father and mother, and is glad that she feels sorry, that she punished herself. The

weeping spell lasted long after the analytic hour. Analytic material is infantile—she feels deep vague grief.

Prediction: premenstrual depression, low hormone level.

*Vaginal smear 2/3:* More normal cells, occasional cornified cell. Low hormone level.

2/4: "I wept yesterday for a very long time. It poured. I felt it rather difficult to breathe. I felt guilty and insincere. I dreamed:

I was in my sister R's house. She had a negro housekeeper who had syphilis. She was not in an infectious state. But she took care of the baby. I had the feeling she should have told it to R. I have to tell it to R. I see her go to the toilet."

In the dream her identification with the negro housekeeper is obvious. Syphilis is punishment for sexual guilt; her sexual guilt made it impossible to have an undisturbed relation to the baby. The yearning for the baby continued in this dream. And she complained that her breasts hurt. The further analytic material of the hour brought out her infantile conception of childbirth. The same concept was obvious in the previous cycle, in the material on 1/7, but highly charged with emotions; childbirth, defecations: both were annihilation. Now, however, instead of fear of childbirth, there is yearning for a child; deep regret that she never will have a child again. There is a feeling of loss. But childbirth itself is like a bowel movement: losing something. But there is no fear, no associated feeling of self-destruction.

Prediction: low hormone level. Late premenstrual.

*Vaginal smear 2/4:* More normal cells. Low hormone level.

After the hour the menstrual flow started suddenly. This was a premenstrual phase with progressively diminishing hormone production.

We have presented three premenstrual phases of the same patient, each differing from the others: in the first, progesterone production diminished and estrone increased; in the second, estrone increased while progesterone

variety of premenstrual phases is not unusual in a single individual. Table I summarizes the premenstrual phase of a cycle of patient R. E. which shows low hormone production. On page 248 of the first part of this paper<sup>3</sup> we pre-

TABLE I  
CASE R.E. CYCLE: JULY 1-AUGUST 4

Date	Psychoanalytic Material	Prediction	Physiological Findings
July 25	Dream: 1) Prostitution phantasy, 2) Fear of sex attack, 3) Very depressed, womb phantasy.	Estrone and progesterone function. Premenstrual.	Regressive progesterone. Still 75% cornification.
July 26	Fear and wish of being attacked sexually. She is obsessed by the idea of penis.	Estrone tension. Premenstrual.	Diminishing progesterone. Minimal cornification. Premenstrual.
July 27	Conflict with mother on two counts: a) mother interferes with her heterosexual desire, b) mother deprives her of her pregnancy.	Progesterone increased. No estrone.	Regressed estrone. Premenstrual. Low hormone level.
July 28	Herpes labialis. Dream: Identification with brother. The masculine identification may protect her against heterosexual attack. Fear and wish of attack.	Estrone. Diminished progesterone.	25% cornification. Slight folding and aggregation.
July 29	Dream: 1) Masochistic concept of female sexuality; to be woman means bleeding and death. 2) Brother-incest. Identification with brother on masochistic basis.	Estrone increased. Premenstrual.	Increased cornification. Occasional red blood cells. More secretion.
July 30	Nervous, more fear.		Same.
July 31	No analytic material.		Same.
August 1	Dream: preparation for menstruation. Passive, withdrawing, depressed.	Regressive hormone.	Extreme regression. More debris.
August 2	Feels better. Dream: 1) Mother is protection. 2) Father is also protection. 3) Pregnancy = anal birth dream. Fear of pain.	Low hormone level. Progesterone regressed.	Extreme regression.
August 3	Depression. She talks about her fears. The anxiety is not acute. Vague desire to overcome the fear of pain.	Psychoanalytic material does not show hormone characteristics. Menstrual.	Occasional red blood cells. 25% cornification.
August 4	Cheerful: She talks about the fear of heterosexual and homosexual desire. Primal scene material. Identification with mother.	Low hormone level.	Menstrual. 25% cornification.

was maintained; in the third, both hormones progressively diminished. Related to the hormone levels, the conscious emotional state was tense, aggressive and extraverted in the first; fearful, desperate and self-destructive in the second; lacking aggression, dependent and sad in the third. Such a

sented another cycle of the same patient where the premenstrual phase was characterized by increasing estrone production. The flow started at the 90 per cent cornification level.

We now present in succession the premenstrual phases of three cycles of

<sup>3</sup> Cf. fn. 2, p. 464.



patient V. M. which not only confirm the correlation between hormone production and instinctual tendencies, but suggest also the possibility that psychic factors affect gonad function. In her cycle 1/12-2/8, the first premenstrual evidence occurred 1/31 when her emotional state was "startling". She was sexually very demanding. The association material showed mother-conflict, demands upon mother. The oral demands were aggressively expressed. Premenstrual evidence.

*Vaginal smear 1/31:* More aggregation and secretion, occasional red-blood cell. Minimal cornification. Early premenstrual.

On 2/1 she was anxious, apprehensive, cried, raved about her mother, jealous of her siblings. The association material showed hatred and guilt toward the mother: fear that mother might take away her child just as she wanted to have mother's child for herself. This was "progesterone" content; but the great aggressive tension indicated that both hormones were present.

*Vaginal smear 2/1:* Marked desquamation and aggregation, with increasing cornification. Clearly premenstrual.

On 2/2 *DREAM:* Social gathering—apartment. I heard that a murder took place. There were several people in the hall with me. A suspicious looking man was looking back, and I thought that he was a suspect. He was running away. I went downstairs and he was with somebody else. It seemed he also killed a woman and I was afraid. He embraced me. I found it was L.

In this dream the masochistic sexual concept found its solution in her normal heterosexual wish. She was not angry on that day. The estrone-determined heterosexual tendency seemed free from any conflicting lutein tendency: Prediction: Increased estrone—no progesterone.

*Vaginal smear 2/2:* Mostly normal cells. No aggregates.

2/3: She was again angry, because her demands were not satisfied. She reported the following dream:

Mother, father and I are in a place, like a barn. I have a pail, with dirt in it. I want to wash it out. I looked at my mother. She objected and showed it. I put it in the stream and I saw the water becoming very dirty, like sewage from the barn. I wondered how this dirty water would wash out the pail, but it did. My brother brought in the cows. Mother showed me family heirlooms, lovely things. I began to feel sex feelings. A studio couch was wide open. As I got into it I felt another girl there. I was face down and she had her face up. I felt both genitals. It seemed definitely so.

Associations: I had the male sex feelings, sex phantasies and experiences.

While the bisexual content of the second part of the dream is clear, it is important to observe the regressive character of the first part of the dream, viz. vagina—dirty pail—sewage—urine—masculine sexual excretion. Masculine material, fertilizer—sewage. The anal and urethral regression in the dream indicated regressive progesterone function. Bisexual tendency. Increasing sex tension indicated increasing estrone.

*Vaginal smear 2/3:* Extreme secretion (masturbation or coitus?) with much cell debris. Late premenstrual.

2/4: She had had intercourse, but was still very tense, irritable, critical, talked about male genitals, and her phantasies. Increased heterosexual tension.

*Vaginal smear 2/4:* Like that of 2/3, but with few sperm.

2/5, 2/6. *No analytic session.*

*Vaginal smears 2/5, 2/6:* Show slightly increasing cornification.

2/7: Heterosexual need was great



during the weekend. Satisfactory coitus. She felt herself attractive to men and was very proud of it. The increased heterosexual need had had a satisfactory discharge, which made her happy, increased her self-esteem. The emotional state was similar to the estrone-determined emotions of the pre-ovulative phase.

*Vaginal smear 2/7:* Cornification markedly increased (60 per cent).

2/8: Patient talked dramatically, giving the impression that she wanted to expose herself to everybody near and far who could hear her. There was great elation and narcissistic satisfaction in her behavior as well as in the content of the material. Prediction: like an ovulative phase, high estrone level.

*Vaginal smear 2/8:* Complete cornification, but beginning of menstrual flow.

She did not notice the flow at all. It is possible that the high estrone production was responsible for the unusually scanty flow at that time. But it is surprising that a patient taking her vaginal smear daily and accustomed to observing herself closely—(she used to report the "spotting" before and after the flow)—did not notice the bleeding at all. She was absolutely convinced that she had missed the menstrual flow, and during the following four weeks she was worried about the possibility of pregnancy. Why was she unaware of the spotting? Obviously there was great emotional readiness to suppress the menstrual flow. This readiness might be responsible for the rather scanty flow. The satisfactory coitus on 2/7—her happiness and narcissistic behavior on 2/8 offer other explanations: 1) she was so satisfied with her sexual life that she did not want to interrupt it by menstrual flow. 2) She did not want to be reminded of being a woman, castrated—bleeding. 3) Unconsciously

she wanted and expected to become pregnant from the physically and emotionally satisfactory coitus. The records were not adequate to select one or another of these alternatives, until the records of the next month, which showed her preoccupation with pregnancy and point to the pregnancy wish as being the most likely factor in the patient's partial suppression of the flow.

*Vaginal smears on 2/8 and 2/9:* Show complete (100 per cent) cornification, abundant red-blood cells, much secretion—obviously menstrual.

Unfortunately patient did not prepare smears on 2/10 and 11.

The smear on 2/12 looked typically post-menstrual and consisted chiefly of normal cells.

The following cycle, beginning with the unnoticed flow was from 2/8 to 3/7. She first noticed flow only on 3/8. It was essentially a normal cycle. Ovulation took place on 2/18 and was followed by a clear lutein state from 2/19 to 2/25, when the first premenstrual evidence (cornification) appeared in the vaginal smear. (There were no analytic sessions.) From 2/25 to 2/28 there was a period of low, variable hormone production as is frequent in the premenstrual phase. The analytic material was dominated by progesterone. On 3/1, the late premenstrual period started with increasing heterosexual tension. There was no regression of lutein activity in the psychoanalytic material.

On 3/1, the dream expressed the wish to be feminine, the wish to be given gifts. She wants to begin again with her marriage, more romantically, with narcissistic gratification.

"J. (husband) said 'We should elope and get married.' I decided we should get married the second time the right way. We decided to arrange a big wedding. We had

a lot of people. I saw a balcony that could be decorated prettily".

The associations were more demanding, expressed her dissatisfaction. Her breasts ached. She expected and was worried about pregnancy. Prediction: Heterosexual wish is estrone material; demanding receptive and narcissistic attitude is progesterone material.

*Vaginal smear 3/1:* More aggregation and debris, few cornified cells and red-blood cells. Premenstrual.

On 3/2: "I feel terrible, I lost some sleep on account of a dream: I was on the couch in the analytic room. I became angry and I left. It was a delightful feeling. You (male analyst) called me back. You would not let me go.

I saw a girl dying in bed, in her hand a rose tree, a religious figure—symbol of death of the Savior. I wanted one of the roses and I wondered if anyone would see if I picked it. I heard nurses talking, and then I saw I had two flowers in my hand. I was going downhill to the basement. I was afraid, something was going to injure me. I found a little hole in a small board. I was angry with you and I was never going to allow anybody to treat me like this."

The wish to be loved, narcissistic, flirtatious feminine attitude is expressed in the first part of the dream. In the second part of the dream the dying girl symbolizes the dying virginity, from whom she wishes to get the symbol of virginity. She recreates the fear of being hurt by sexuality. Defense against passive feminine wishes which she enjoyed. Prediction: Heterosexual wish, but narcissistic defense. Still progesterone and estrone activity.

*Vaginal smear 3/2:* Increased cornification and less aggregation.

3/3: Dream showed guilty feelings because she is not a virgin any more. The vagina is not clean—impregnation fear. Associations showed the wish to be a feminine "real woman", not a

masculine woman. This indicates the persistence of progesterone and estrone.

*Vaginal smear 3/3:* Essentially like that of 3/2. Slightly more debris—lower hormone level.

3/4: Patient is ambivalent and dependent on the mother image, afraid lest she take away her child. This fear that mother begrudges her the child repeats itself in her premenstrual material. This time it may have been activated by the fear or expectation of her supposed pregnancy. No heterosexual material.

*Vaginal smear 3/4:* More secretion; much less cornification.

3/5 and 3/6, no psychoanalytic sessions. 3/7: She decided to carry out the pregnancy if she is pregnant. Anxious about a pregnancy test, demanding and irritable.

*Vaginal smear 3/7:* Abundant secretion, but low hormone level. Menstrual smear.

The patient recognized the menstrual flow on 3/8, and had a normal flow until 3/11.

It is very interesting to compare this premenstrual material, where the patient did not expect the menstruation, but thought she was pregnant, with the premenstrual period of the following cycle of the same patient. (The cycle from 3/8-4/5, is a normal ovulative cycle; ovulation was on 3/20.)

3/23: The first premenstrual evidence appeared as highly dynamic analytic material, then a lutein phase developed again, and on 3/31, the "late premenstrual" phase started.

4/1: Patient was depressed, "there is nothing in my life to be happy about". She cried "My son likes his father better than me". She accused her husband of seducing, alienating her son away from her. The analytic material

showed only the mother-child conflict. Progesterone.

*Vaginal smear 4/1:* Abundant debris, occasional red-blood cell. Low hormone level, but progesterone dominance.

4/2 and 4/3: No psychoanalytic material. During the weekend she was more relaxed and willing to admit that the idea that her husband separated her from her child was pure imagination. No vaginal smears.

4/4: Felt tense. She thought she was pregnant. *DREAM:* I was in Germany in great trouble, trying to get away from Hitler, trying to seek protection from Goering.

*Associations:* She read a story: "a woman left Germany because she was pregnant by a Jew". This dream, although it seemed to have heterosexual content, expressed mainly the wish and fear of pregnancy, and the dependent attitude of a pregnant woman. Increased tension—increased estrone output. Pregnancy wish, lutein material.

*Vaginal smear 4/4:* More secretion and aggregation. More cornification (35 per cent).

4/5: *DREAM:* Mary, my high school chum, and I were sitting in an office. I saw across, a worker in another building getting ready to jump off to commit suicide. Then I began to feel that other people should see it too. I told Mary to look, when Lena jumped. I went downstairs. She was saved, as the place from which she jumped was not so high.

*Associations:* "Mary is the name of my little sister. My mother threatened to commit suicide, it frightened me, yet I wished it. It would have been a relief. I could not express love for her, only my hatred. I told my husband 'If I should die he should tell my mother how I loved her'".

The dream expressed ambivalence toward sister and mother and symbolically, the fear of childbirth. The

awareness of her genitals was so strong that patient felt "bursting". Increased eliminative tendency indicated slight progesterone regression.

*Vaginal smear 4/5:* Marked desquamation of normal and aggregated cells, few cornified. Progesterone dominance.

4/6: *DREAM:* I seem to be in the clinic—prenatal. I saw a little girl of five or six coming out of a taxi, pregnant. I tried to help her. She was carrying the baby very low. I asked her if she had a tummy ache. I was concerned if she was in labor. They took her to examine her.

After this dream the menstrual flow started. The associations to the dream expressed a strong wish for pregnancy, "I want to be a woman", and regret that she menstruates. The onset of the menstrual flow was sudden, with cramps, discharge of clot, like an abortion. We see in this case that although this patient consciously avoided pregnancy, the unconscious pregnancy wish influenced the psychological material very strongly.

*Vaginal smear 4/6:* Same as 4/5 except that there is some blood.

We presented three premenstrual periods with the following characteristics: the premenstrual phase in the first cycle showed decreasing progesterone and increasing estrone; ending at a high estrone level, like a preovulatory phase: satisfactory and narcissistic. The next premenstrual phase showed increasing estrone and maintenance of progesterone. We know that the psychological content was influenced by the expectation of pregnancy. In the third cycle there was low estrone production and maintained progesterone, though there was no justified fear of pregnancy. This is evidence for the closeness of the correlation, but naturally sheds no light on the problem of primacy of gonad or psyche.

The first evidence of impending menstruation is a marked regression in progesterone production which in the psychoanalytic material takes the form of eliminative tendencies. These may be expressed on the genital or pregenital levels. On the pregenital level, they may take the form of urethral or anal soiling, and need for discharge. For example of patient R. R., 1/19/39:—

*DREAM:* My mother and I washing dirty clothes together. I was not mad at her. I was wondering how she would get the dirty water out of the tub.

In this dream the regression has urinary symbolism, and is indicative of a regressive progesterone level.

*Vaginal smear 1/19:* Much more degeneration, mucus and debris. Very low hormone level.

Similarly in the cycle 12/10–1/8 of patient G. S. (pp. 16–17) on 1/6–1/7 the dream concerned bowel movement, clearly an example of anal discharge.

On the genital level, the eliminating tendencies may take the form of dreams or phantasies concerning childbirth, bleeding, loss, abortion or castration; *vide* G. S. 1/7/38 (p. 17) when these tendencies were expressed on both the genital and anal levels with feeling of self-destruction. Also *vide* V. M. 4/6/38 (p. 28) when the tendency was expressed as parturition. As an example of the depressed feeling of loss, G. S. dreamed on 11/13:

"I was in a depressed or melancholy state: my baby was dead. Perhaps there was some talk about reconstructing the child."

and on 11/14:

"All day I had the feeling that I suffered a loss, that I don't have a child."

She recalled during the analytic hour the circumstances and her emotional reaction of her first menstruation when

she was 12 years old. She was very tearful. The menstrual flow started the following night 11/14.

*Vaginal smear 11/14:* Abundant secretion of mucus and leukocytes, aggregation. Occasional cornified cell. Low estrone.

As an example of menstruation as castration or death we present the following dream of G. S. on 10/21:

I observed a body lying in the street. It seemed to be writhing convulsively in a sort of agony. Then there were two bodies, lying side by side. Then one of the bodies was headless. The head had dropped off. There was a hideous red gash—a bloody gash—around the torso, where the neck had been. Then neither body had a head.

I felt I had to help. Someone had to help. The girl or woman was in agony and kept repeating, "it's all so hopeless." I went to her. Suddenly the girl was standing on the sidewalk. She was smiling happily. Her head was on her body again and she appeared to be more cheerful, as though she didn't fear that it would be detached again. She asked for some creme de Cracow, mispronouncing the last word. I said "You mean creme de cocoa" and was willing to give it to her.

*Vaginal smear 10/21/38:* showed low hormone level—premenstrual.

This dream was as highly charged as if there were a high hormone level. The patient, telling this dream, talked in a hoarse voice. During the last two days she had been nauseated and had difficulties with her voice: "I thought you were choking me". As association to the dream she repeated in speedy emotional talk the conflict with her mother after her brother was born; her associations were concentrated on male genitals. The whole material was highly charged emotionally. Analysis of this dream shows the fears connected with menstruation which is feared as castration—as destruction of her own body. It also shows that the hopelessness is not profound, for if a helpful



person (good mother) were to give her attention, love, food (creme-milk) then life would not be hopeless—it would not be necessary to feel that bleeding is annihilation.

Castration fear usually appears in the late premenstrual material as a reaction to loss and discharge, particularly when some estrone production is present. The eliminative tendencies appeared highly charged with energy in the late premenstrual material, whenever progesterone and estrone production which had been maintained suddenly regressed during the premenstrual phase.

The emotional reactions during the last premenstrual days are more acute than in any other phase of the cycle. Generally only this part of the cycle had been recognized as the cyclically recurring neurosis of women. Freud wrote an interesting reference to the importance of periodicity in women in an early article on "Types of Neurotic Nosogenesis" (5).

"As is well known, such rather sudden intensifications in libido are regularly connected with puberty and the menopause. The dissatisfied and dammed-up libido may now open up the path to regression and excite the same conflicts as in the case of absolute frustration."

That is, during the premenstrual phase of every cycle, women may repeat the neurotic constellation, which they experienced at puberty as a preparation for or reaction to the menstrual flow.

Since Freud wrote his first articles relating neurotic reactions to biological changes, there has been a prolific psychoanalytic literature about the dynamics and emotional effects of menstruation. The main publications are reviewed in a small monograph by Mary Chadwick (2).

It is not within the scope of this

paper to discuss the entire psychology of menstruation. Our objective is to demonstrate how the gonad function is reflected in the emotional state of women, during this crucial phase of the cycle. The great variety of our material during the premenstrual phase shows "dammed up" highly charged libidinous or aggressive material—such as Freud described, not only when there is a high hormone production, but even when hormone production is low. Thus we conclude that the premenstrual phase is characterized by a psychodynamic and psychosomatic response, more complex than would be expected on the basis of hormone quantities alone. Sociological, developmental, constitutional factors may all be involved. Many women, who do not show marked or neurotic reactions corresponding to their gonad function during other phases of the cycle, show psychological reactions during the premenstrual phase.

Restlessness, irritability, over-sensitiveness to all kinds of stimuli are generally accepted as quasi-normal during the premenstrual-menstrual day. Fatigue, and tearfulness, emotional withdrawal with more or less severe depression and a feeling of regret and inferiority frequently characterize the premenstrual depression. In some cycles the eliminative tendencies are highly charged with aggression to which the reaction is anxiety. Fear of what will happen to one's body often suffices to describe the emotional condition preceding the menstrual flow. Fear of pain, fear of mutilation, fear of birth, are expressed in the psychological material with a great individual variety of defenses.

The tense, fearful psychosomatic state usually relaxes when flow starts. An observation not widely accepted, but true for our group of cases at least, is that adult women accept the men-

TABLE II

CASE: R.R.

CYCLE: DECEMBER 28-JANUARY 20, 1939

Date	Psychoanalytic Material	Prediction	Physiological Findings
Jan. 10	Dream: Incestuous wish. Unhappy, depressed. Cannot work.	Low estrone.	Still marked aggregation and folding. Slightly less lutein.
Jan. 11	She feels depressed, incapable, irritable. Dream: Urethral regression, sadomasochistic tendency.	Regression in level of progesterone.	Regressive luteal smear, degeneration of cells.
Jan. 12	Resistance. No sexual desire. Anal regression.	Regressive progesterone.	Degeneration.
Jan. 13	No analytic material.		Desquamation, degeneration. Low hormone content.
Jan. 14	Depressed, sleepless, critical. Dream: 1) Incorporative penis wish. Aggression toward pregnancy. 2) Incest. Primal scene. Oedipus complex: loves the father and is afraid of the mother.	Lutein regressive. Estrone increased.	No smear.
Jan. 15	No analytic material.		Type 5, 6—early premenstrual.
Jan. 16			Type 6, 7—late premenstrual.
Jan. 17	Angry, tense, narcissistic defense against heterosexuality. Narcissism destroys libidinous wishes.	Low estrone.	Minimal cornification.
Jan. 18	Friendly, less tension. Amiable mood. Dream: Identification with mother: to be woman means to be dirty: tendency to discharge. Dirty urine identical with content of vagina—blood or child.	Late premenstrual. Regressive progesterone.	More cornification. Premenstrual. More secretion.
Jan. 19	Amiable mood. She has more relaxed and friendly relationship to men than usual.	Low estrone.	Regression to low hormone.
Jan. 20	Feels well, gay. Menstrual flow started without pains.	Low hormone.	Menstrual, still low hormone.
Jan. 21	Dream: Demands on father, not in sexual sense, but for security. Dream has anal regressive content.	Low hormone.	Low hormone level.
Jan. 22	Dream: Demands on father. But here the sexual symbolism displays the unconscious sexual demands.	Starting estrone.	Low hormone level.
Jan. 23	Dream: Aggressive domineering toward sister. Masculine identification.	Increasing estrone.	More secretion. Little cornification, much pyknosis.
Jan. 24	Self-assertive. Feels all right.	More estrone.	Still occasional red blood cells. Bacterial invasion. 75% cornification.

strual flow, once it starts, with emotional relief. Fear, apprehension, rebellion may have dominated the premenstrual phase; when the flow is established, anxiety, apprehension, rebellion cease. Emotional relaxation corresponds to

the sudden decrease in hormone production that ushers in the flow. Failure to find relaxation (*vide supra*) corresponds to continued production of estrone at a high level.

The correlations between emotional

TABLE III  
CASE X. CYCLE: FROM OCTOBER 21-NOVEMBER 18

Date	Psychoanalytic Material	Prediction	Physiological Findings
Nov. 7	Wants to stay in bed. Withdrawing. Dream: oral and homosexual dream content, very depressed dream.	Progesterone function.	Luteal phase.
Nov. 8	Need for oral gratification. Identification with mother with the feeling of inferiority. Wish for masculine identification.	Progesterone. Starting estrone.	Luteal phase regressive.
Nov. 9	Dream forgotten. Talks about her lack of interests. Tearful.	Regression in hormone level.	Minimal cornification. Premenstrual.
Nov. 10	Out-going, talkative, sudden change. Dream: Birth dream. Father is the protective helpful person. Vagina is dirty: dream shows greater emotional tension.	Estrone. Late lutein. Premenstrual.	Minimal cornification.
Nov. 11	Talking in a vague way about heterosexuality. She never has the courage. Compulsive candy eating.	Progesterone and low estrone level.	Minimal cornification. More aggregates.
Nov. 12	No analytic material.		Predominantly luteal.
Nov. 13	Sleepless. Competitive. Hostile. Quarrel with sisters. Oral envy. Compulsive candy eating.	Progesterone—estrone (?)	Predominantly luteal. Low hormone.
Nov. 14	Hostile, depreciative toward men. Castration wish. Depression, with great tenseness. Compulsive candy eating.	Estrone and progesterone. Clearly premenstrual.	Minimal cornification. Clearly premenstrual.
Nov. 15	Vague heterosexual phantasies. Curiosity about masculine genitals. The heterosexual material less charged with energy than on previous day. Still compulsive candy eating.	Estrone plus regressive progesterone.	Regressive in hormone.
Nov. 16	She awoke crying in angry rage from a dream. Dream: 1) Siblings rivalry. 2) Dependent wish to stay with the mother expressed by womb symbolism. Still compulsive candy eating.	Mainly progesterone. Estrone (?)	Same.
Nov. 17	All day on 16th depressed. Disoriented. In doubt about everything. Today weary, passive—dependent, need for reassurance. Afraid to start anything.	Regressive hormone.	25% cornification. Occasional red blood cells. Debri, late premenstrual.
Nov. 18	Menstrual flow started 17th.		Menstrual, low hormone.
Nov. 19	No analytic material.		Low hormone.
Nov. 20	No analytic material.		No smear.
Nov. 21	Dissatisfied, demanding, no erotic feelings.	Low hormone.	30% cornification.

state and hormone production during the period of flow show the same shifting, variable quality that was deemed typical for the premenstrual phase. Womb and nursing phantasies, the wish to care for a baby, are commonly expressed in the dreams of particularly the second and third menstrual days. Occasionally the entire period of flow

is one of depression, feeling of loss. At other times the period is one of elation related to preovulatory development. It then takes on the characteristics which we described in detail in Part I of this publication. To present the psychoanalytic and smear material in detail for the period of flow would prove nothing new about the correlation and

TABLE IV

This cycle shows a sudden increase of estrone just before the menstrual flow started.

CASE X.

CYCLE: NOVEMBER 18-DECEMBER 17

Date	Psychoanalytic Material	Prediction	Physiological Findings
Dec. 9	Dream: 1) Infantile sex phantasies. 2) Fear of being attacked. 3) Intercourse=murder. 4) Masochistic concept of female sexuality. Oral and womb symbolism.	Progesterone and estrone. Premenstrual.	Extreme output of secretion. Minimal aggregation. 5% cornification. Earliest premenstrual.
Dec. 10	Dream: 1) Wish to withdraw and be protected at home. 2) Fear of being attacked. 3) Sister protects her. The conflict is the same, as on the previous day, but vague, less emotional charge.	Regressive estrone. Progesterone dominance.	Marked degeneration of aggregated cells. Low hormone level.
Dec. 11	No analytic material.		Same—slight increase in progesterone output.
Dec. 12	No analytic material.		Same.
Dec. 13	She feels sorry for herself. She is full of doubt.	Regressive hormone.	Same.
Dec. 14	The same mood. No analytic material, which which would permit diagnosis.	Low hormone level.	Same.
Dec. 15	Sudden change. Masturbation on previous evening. Phantasies about abortion. Fear of abortion. Fear of being castrated. Detailed phantasies about suffering by labor, abortion. Masochistic phantasies in which rectum and vagina are identified as in the birth-theories of children.	Regressive progesterone on eliminative level. Low estrone.	Reappearance of cornified cells. Estrone increasing. Still some residual progesterone production.
Dec. 16	Completely superficial material. Unimportant details.	Regressive compared to previous.	Again debris—marked regression in hormone production.
Dec. 17	Highly charged dynamic dream: 1) Mother-womb protects her against sex wishes. 2) Very intense heterosexual wish. There is not only fear of attack, but also very aggressive fight with man.	High estrone level. Low progesterone.	Cornification 50%; rest of smear consists of debris. Marked increase in estrone production.
Dec. 18	No analytic hour.		Menstrual flow. 75% cornification. No progesterone.
Dec. 19	Very superficial. Amiable mood. Menstrual flow profuse. Clots. Cramps.	On analytic material hormone diagnosis not possible.	Menstrual flow. 90% cornification.
Dec. 20	Still menstruating. Amiable mood. Sexual curiosity.		Cornification practically complete. Minimal aggregation.

would involve extensive repetition. Therefore we present in tabular form several premenstrual-menstrual phases. It should be noted that the period of menstrual flow is included.

We have presented the different types of premenstrual-menstrual phase. They demonstrate 1) that careful analysis of the recorded psychoanalytic

material permits us to recognize the effects of the gonad hormones, estrone and progesterone, qualitatively, despite their daily (shifting) changes and although they may be produced in but small quantities during this phase of the cycle; 2) that emotional reactions in the premenstrual phase may be more intense, more acute than in other



phases of the cycle. Thus quantitative evaluation of the psychological material does not always parallel the quantitative estimate of hormone production.

#### SUMMARY

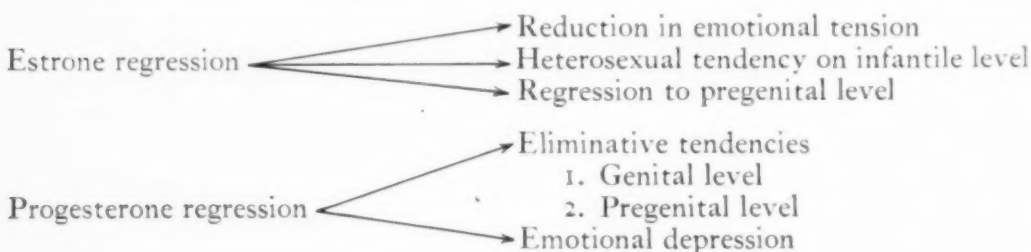
We have presented and discussed a selection of premenstrual-menstrual phases of 125 cycles of 15 patients. Careful study of vaginal smears and basal body temperatures on the one

Since the premenstrual-menstrual phase of the cycle is one of low hormone production, certain other characteristics appeared, as summarized in the following table which is self-explanatory in the light of the material presented.

In addition to confirming the correlations, we have described and discussed the psychological concomitants of regression in hormone production.

TABLE V

Phase of Cycle	Hormone State	Psychological State
Early premenstrual	Minimal estrone. Dominant progesterone.	Incipient reoccurrence of heterosexual tendency. Mostly impregnation fantasies.
Premenstrual	Diminishing progesterone. Variable but low estrone.	Mixed oral-incorporative and heterosexual fantasies. Generally quiescent phase.
Late premenstrual	Sudden extinction of progesterone.	Eliminative tendencies on genital level —childbirth. —bleeding. —abortion, castration. on pregenital level —anal or urethral discharge. —vomiting. Emotional tension or depression out of proportion to hormone production.
Menstrual	Low hormone.	Emotional relaxation.



hand, and of psychoanalytic records on the other hand confirm the correlations inferred in Part I of this publication.

1) The presence of estrone (cornification in the vaginal smears) corresponds to the presence of active heterosexual libido.

2) The presence of progesterone (desquamation, aggregation, folding, secretion in the vaginal smears) corresponds to a passive, receptive instinctual tendency.

The data also suggest the possibility that psychological factors influenced the gonad function. In this phase of the cycle, this may account for the occasional maintenance of progesterone production.

During the late premenstrual-menstrual phase of the sex cycle, emotional reactions are more intense and complex than can be explained on the basis of the then existing hormone production. After the menstrual flow is established, there is an emotional relaxation which

again corresponds to the low hormone production characteristic for this period.

### CONCLUSIONS

1. The simultaneous use of day-by-day study of vaginal smears and basal body temperatures on the one hand, and of the analysis of the recorded psychoanalytic material on the other hand, provided clear correlations between the physiological and psychological processes.

2. The investigation confirms the probability that in the adult woman, instinctual drives are related to specific hormone functions of the ovaries.

3. The premenstrual-menstrual phase of the sex cycle is one of diminishing progesterone and low, but variable estrone production. The metabolic gradient is generally downward.

4. Corresponding with the hormone levels, the instinctual tendencies are on the genital level when hormone production is relatively high; on the pre-genital level when hormone production is very low.

5. Upon extinction of progesterone, eliminative tendencies appeared in the psychological material. This was most common in the late premenstrual period.

6. There is a semi-quantitative correlation between hormone production and psychic tension.

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## THE HYPOTHALAMUS AS A THERMOSTAT REGULATING BODY TEMPERATURE\*

S. W. RANSON, M.D.

THE REMARKABLY STABLE BODY TEMPERATURE of warm blooded animals is evidence of an efficient thermostatic control. Heat is continuously formed in the body even during rest and the amount thus formed is very greatly increased by muscular activity. To maintain an even temperature the rate of heat loss must be adjusted to the rate of heat formation and this adjustment is complicated by changing environmental temperature. A high external temperature reduces heat elimination, and vigorous muscular exercise increases heat production, causing the body temperature to rise and thus starting heat loss activities such as dilatation of the cutaneous blood vessels and sweating. In carnivores panting is the chief means of heat elimination. Exposure to cold causes shivering, which increases heat production, and constriction of the cutaneous vessels which reduces heat loss by diminishing the flow of warm blood to the skin.

In addition to these automatic adjustments other more or less conscious reactions take place in the interest of temperature regulation, such as seeking a cool place and remaining quiet and relaxed when external temperatures are high, or seeking a warm spot and reducing the amount of exposed surface or engaging in vigorous activity when the temperature is low.

We shall consider the automatic regulation of body temperature in so far as this is controlled by the hypothalamus. Granting for the moment that this part of the brain acts as a

temperature regulating center, many questions remain to be answered. Is the center activated directly by the temperature of the blood or reflexly from the thermal endings in the skin? What is the exact location of this center in the hypothalamus? How far is it indispensable and how far can its function be taken over by subsidiary centers in the brain stem and spinal cord?

Taking up the last question first it may be said that, following more or less complete elimination of the hypothalamus, body temperature, which at first falls very low, tends gradually to return toward normal. Recent foreign investigators, led by Thauer (10), have claimed that animals in which the spinal cord has been transected in the lower cervical region are able after a time to regulate their temperatures in a fairly normal manner. Even if one makes due allowance for some over-enthusiasm on their part it still remains a fact that within a few weeks following the transection a remarkable amount of recovery occurs. On the day following section of the cervical spinal cord cats must be kept at a room temperature of 90° to prevent chilling, but after two months they do not lose heat when kept in a comfortably warm room. The recovery is far from complete, however, because if they are placed in a moderately cool room their temperature falls rapidly (Clark, 2). This marked, but definitely limited, improvement is due in part at least to a return of tone in the cutaneous vessels resulting in a reduction in the amount of blood reaching the surface of the body. The vigorous shivering which

\* From the Institute of Neurology, Northwestern University Medical School.

occurs in the neck and shoulders and in those forelimb muscles which are innervated by the cord above the level of the transection is an important factor in preventing an even greater fall in body temperature.

A similar and perhaps even more marked recovery is seen in cats with hypothalamic lesions so placed as to

gree of recovery had taken place we studied their reactions to heat and cold in some detail and the results of these studies will be presented a little later.

The reason for the partial recovery is not well understood. It may be that it is due in part to compensatory activity of lower lying parts of the nervous system. But we shall not consider

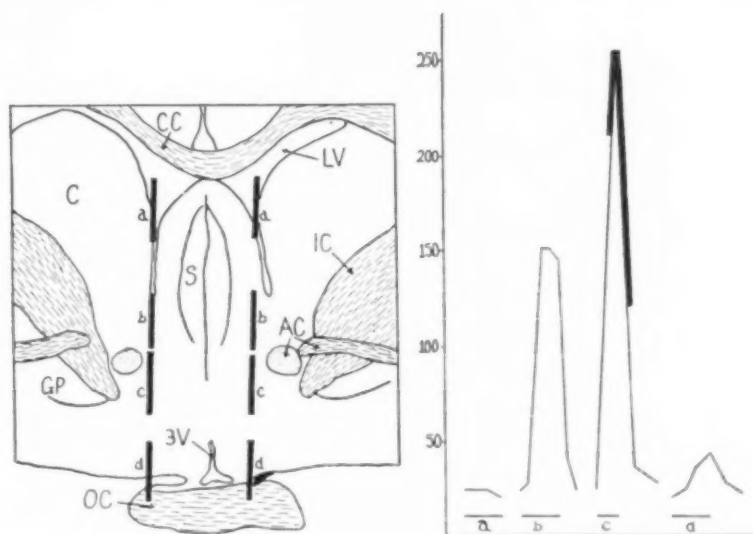


FIG. 1. Schematic drawing from a transverse section of a cat's brain, passing through the anterior border of the optic chiasma. Four different positions of the bare ends of the electrodes are shown at *a*, *b*, *c* and *d*. The accompanying chart shows the respiratory responses obtained by passing a high frequency current between the electrodes in each of the four positions *a*, *b*, *c* and *d*. The rate of respiration is shown on the ordinate; panting is shown by a heavy line. Period *a* represents 5 minutes, other times in proportion. Abbreviations as listed under Fig. 3. Reproduced from *Journal of Neurophysiology*, Vol. 1.

cause postoperative falls in rectal temperature. Such cats, although kept in an incubator set to run at about  $85^{\circ}$ , had very low rectal temperatures on the first postoperative morning; but in a few days they recovered sufficiently so that they ran approximately normal temperatures when kept at an average room temperature of  $75^{\circ}$ . Although the recovery was such that these cats got along very well in a comfortably warm room they became chilled or overheated when exposed to moderate cold or heat. After this de-

this phase of the problem. Our experiments have been designed to reveal disturbances in temperature regulation which are evident weeks and months after lesions have been placed in the hypothalamus.

There is reason to believe that heat regulating centers are activated reflexly from the skin and directly by the temperature of the blood. The case for reflexes need not be discussed. There is, for example, plenty of evidence for reflex sweating (Kuno, 5). It is only recently, however, that conclusive evi-



dence has been obtained that a center controlling heat loss activity can be activated directly by heat. In experiments on cats it was found that localized heating of a limited region of the brain caused panting and sometimes also sweating on the pads of the feet (6).

The heating was accomplished by passing a high frequency current of low

plane passing half a millimeter in front of the crossing of the anterior commissure and through the anterior border of the optic chiasma. When the bare ends of the two electrodes had been inserted as far as *a*, the current was turned on and produced very little effect. When the ends of the electrodes had been pushed down as far as *b*, the heat produced by the passage of the

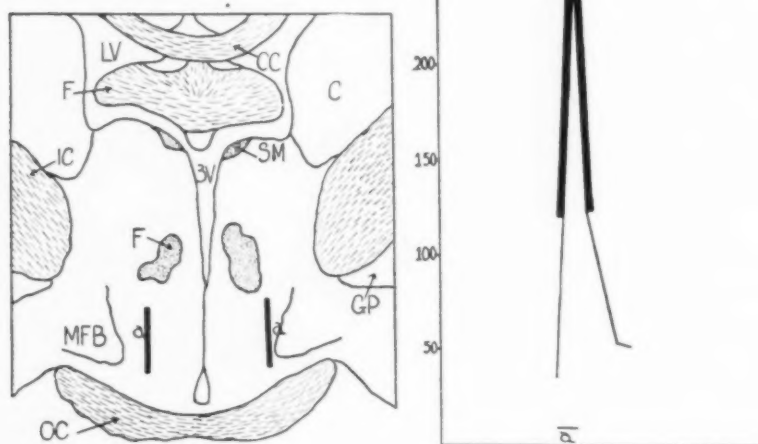


FIG. 2. Schematic drawing from a transverse section of a cat's brain, 1 mm. caudal to that shown in Fig. 1. The position of the bare ends of the electrodes are shown at *a*. The accompanying chart shows the increased respiratory rate and panting (heavy line) obtained by passing a high frequency current between the electrodes for  $2\frac{1}{2}$  minutes. Abbreviations as listed under Fig. 3. Reproduced from the Journal of Neurophysiology, Vol. 1.

voltage, which heats but neither stimulates nor destroys, between the bare ends of two otherwise insulated wire electrodes. These wires were inserted into the brain parallel to each other and 4 mm. apart. Using the Horsley-Clarke stereotaxic instrument the two electrodes could be inserted simultaneously to any desired depth and could be removed and reinserted in a different position as often as desired.

In the experiment illustrated in Fig. 1 the electrodes were inserted in a

current for a period of five minutes caused an increase in respiratory rate to 150 per minute. With the ends of the electrodes at *c*, the heat produced by passing the current for  $2\frac{1}{2}$  minutes, half as long as at *b*, caused an increase in respiratory rate to 252 and typical panting as indicated by the heavy line in the figure. The passage of the current at *d* had very little effect.

After the current was turned on it took about one minute for the tissue to reach its highest temperature.

Thermocouple readings taken within the brain and 1 mm. from the nearest electrode showed a rise in temperature of  $6^{\circ}$  or more. Since the rectal temperature of the cats averaged  $98^{\circ}$  a rise of  $6^{\circ}$  would bring the temperature of the

tory rate to 288 per minute with panting as shown by the heavy line. After the current was turned off the respiratory rate declined rapidly and the panting soon stopped.

This type of response could be

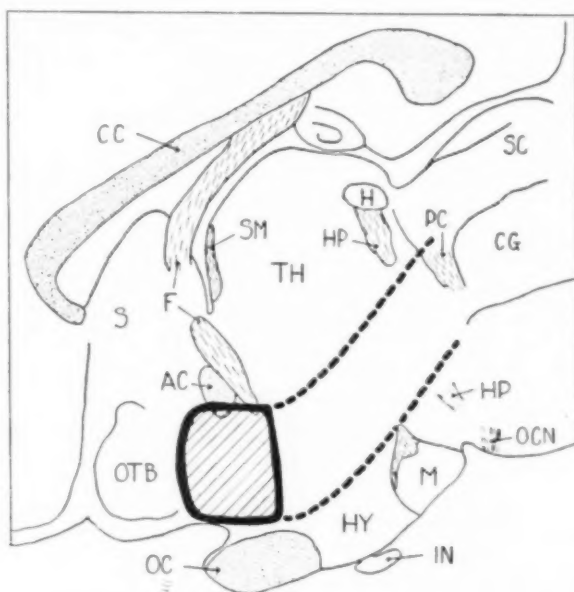


FIG. 3. Schematic drawing showing the outline of the region reactive to heating, projected on a paramedian sagittal section through the brain of the cat. Reproduced from the *Journal of Neurophysiology*, Vol. 1. Abbreviations for Figs. 1, 2 and 3.

AC	anterior commissure	M	mammillary body
C	caudate nucleus	MFB	medial forebrain bundle
CC	corpus callosum	OC	optic chiasma
CG	central grey matter	OCN	oculomotor nerve
F	fornix	OTB	olfactory tubercle
GP	globus pallidus	PC	posterior commissure
H	habenula	S	septum
HP	habenulopeduncular tract	SC	superior colliculus
HY	hypothalamus	SM	stria medullaris
IC	internal capsule	TH	thalamus
IN	infundibulum	3V	third ventricle
LV	lateral ventricle		

brain at a distance of 1 mm. from the electrode to  $104^{\circ}$ .

When the electrodes had been inserted into the brain 1 mm. farther caudad and their bare ends were situated above the optic chiasma at *a* (Fig. 2), the supraoptic portion of the hypothalamus was heated by the passage of the high frequency current for  $2\frac{1}{2}$  minutes, resulting in an increase in respira-

tion elicited repeatedly without moving the electrodes by repeatedly turning the current on and off. The abrupt cessation of the response and its repeated elicitation shows that it was due to activation not to destruction of the area involved.

In a series of experiments similar to that just described, extensive exploration of the forebrain and midbrain of

the cat revealed only a limited region from which responses to heating could be obtained. The outline of this region is shown in *Fig. 3*. It is situated medially and does not extend more than 4 mm. on either side of the midline. Its rostral border is about 1 mm. in front of the anterior commissure and it extends back as far as the rostral border of the mesencephalon. The preoptic and supraoptic regions were the most sensitive to heat. While weaker responses could be elicited from the medial part of the diencephalon behind the optic chiasma, a longer period of heating was required, the respiratory rate did not become as rapid and typical panting was seldom elicited. Other parts of the brain were not responsive.

The reactions obtained were due specifically to the local heating. Faradic stimulation of the preoptic region usually causes slowing of respiration; and while faradic stimulation of the supraoptic region may cause acceleration of respiration, it rarely if ever causes panting, and the acceleration is accompanied by dilatation of the pupils, erection of hair and other signs of generalized excitation. On the other hand heating of this region causes only acceleration of respiration, panting and sweating. The responses were in all respects similar to those obtained by heating the entire animal except that much less time was required to induce the response. Panting began within one or two minutes after the heating current was turned on and stopped within a similar period after it was turned off.

When taken by themselves these experiments serve only as presumptive evidence that the same region is activated normally by heat when the temperature of the blood rises too high. Later we shall reinforce this evidence by showing that this region, which is specifically sensitive to heat, normally plays an essential part in temperature

regulation and that cats in which this region has been destroyed do not pant when overheated.

Experiments on cats and monkeys have shown that the preoptic and supraoptic regions, although important for heat loss, can be destroyed without impairing the animal's ability to keep warm when exposed to a low environmental temperature. The ability to prevent chilling is, however, greatly impaired by properly placed lesions in the caudal part of the hypothalamus. We shall present evidence to show that the temperature regulating center in the hypothalamus is divided into two parts, a more rostral part serving for protection against heat and a more caudal part serving for protection against cold.

Observations on the impairment of temperature regulation caused by hypothalamic lesions have been made on more than 100 cats (3). Bilateral lesions have been placed in various parts of the hypothalamus with the Horsley-Clarke stereotaxic instrument. During the first 24 hours after the operation and sometimes for longer periods the cats were kept in an incubator to counteract the depressing effect on body temperature of the nembutal which was used as an anesthetic and the hypothermia which results from certain hypothalamic lesions. For two or three weeks after the operation daily records were made of the early morning rectal temperature. At varying periods, usually one week and one month and sometimes also two and three months after the operation tests of the ability to regulate temperature were made by placing the cats in boxes artificially cooled or heated. The temperature in the hot box was approximately 104° and that of the cold box varied but was usually in the neighborhood of 40° or 45°.

Cats with extensive damage to the

preoptic and supraoptic regions reacted normally in the cold box but were unable to protect themselves from overheating in the hot box. Their rectal temperature could be raised to  $106^{\circ}$  or

chiasma (*Fig. 4A*), reacted normally in the cold box and showed only a slight impairment of their ability to keep from being overheated in the hot box.

Cats with laterally placed, bilaterally

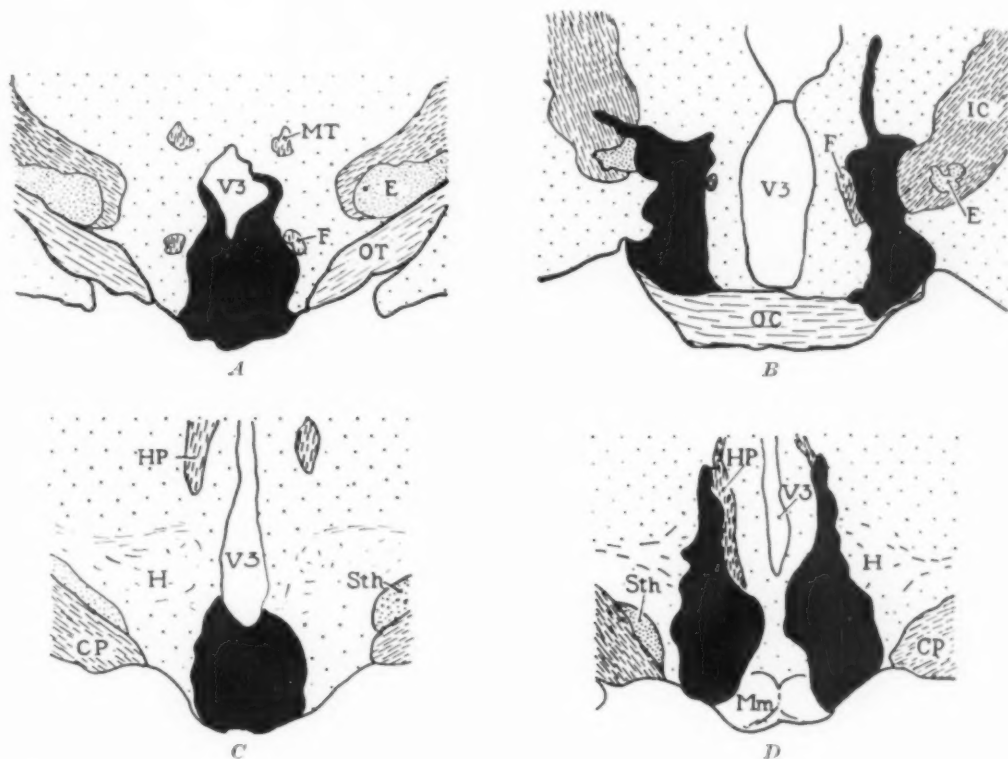


FIG. 4. Schematic drawings of sections through the hypothalamus of four cats, showing the location of lesions in solid black. A, anteromedially placed lesions; B, anterolaterally placed lesions; C, posteromedially placed lesions; D, posterolaterally placed lesions. Reproduced from *Ergebnisse der Physiologie*, Bd. 41. Abbreviations are as follows:

CP	cerebral peduncle	Mm	medial mammillary nucleus
E	entopeduncular nucleus	MT	mammillothalamic tract
F	fornix	OC	optic chiasma
H	field H of Forel	OT	optic tract
HP	habenulopeduncular tract	Sth	subthalamic nucleus
IC	internal capsule	V3	third ventricle

higher without causing panting or much increase in respiratory rate. The failure of these animals to react properly to heat is easily understood when it is remembered that the part of the brain in which the lesions were situated is specifically sensitive to heat.

Cats with moderate sized, medially placed lesions, involving the infundibulum and posterior border of the

symmetrical lesions in the anterior part of the hypothalamus at the level of the optic chiasma (*Fig. 4B*) were unable to keep from being overheated in the hot box and failed to pant or show much increase in respiratory rate when their rectal temperatures were raised to  $106^{\circ}$  or higher. They regulated their temperature nearly but not quite as well as normal cats when exposed to cold.



Cats with medially placed lesions involving the mammillary bodies in the caudal part of the hypothalamus (*Fig. 4C*) showed very little impairment in temperature regulation unless the lesions were large enough to extend from the medial into the lateral hypothalamic areas. They reacted normally when exposed to heat and cold.

Within a few days after the operation most of these cats were able to maintain a normal body temperature when kept in a comfortably warm room. That is to say any postoperative hypo- or hyperthermia disappeared rather quickly. But monkeys with bilaterally symmetrical lesions in the caudal part of the lateral hypothalamus

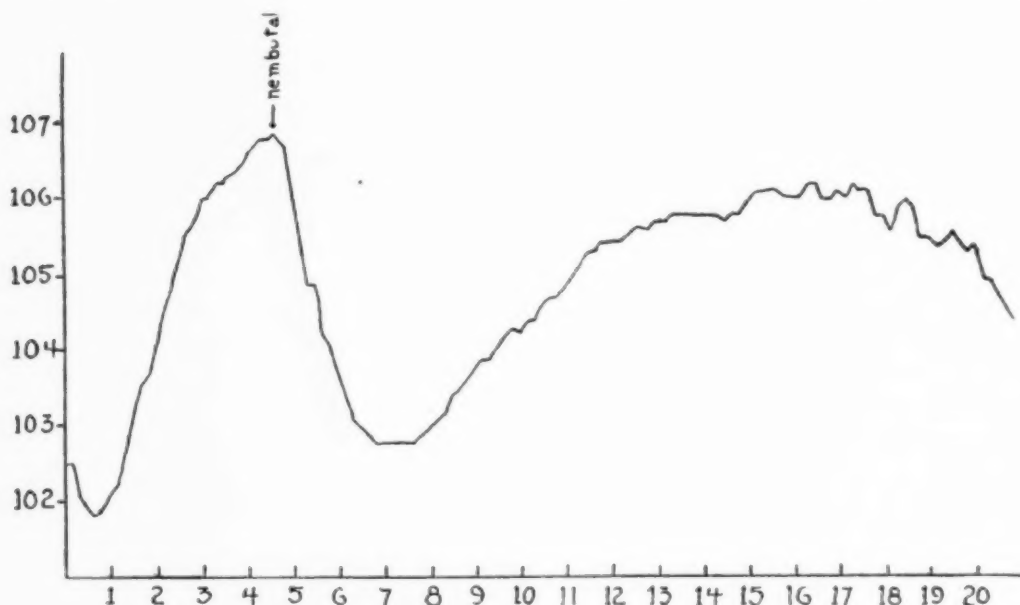


FIG. 5. Chart showing hyperthermia following the placing of lesions in the anterolateral part of the hypothalamus in a cat. Temperature in degrees Fahrenheit and time in hours. Reproduced from *Proceedings of the Society for Experimental Biology and Medicine*, Vol. 39.

Cats with laterally placed, bilaterally symmetrical lesions in the caudal part of the hypothalamus (*Fig. 4D*) showed marked impairment in their reactions to both cold and heat. After three hours exposure in the cold box their rectal temperatures had fallen from  $4^{\circ}$  to  $8^{\circ}$  below the initial level; and they failed to pant or show much increase in respiratory rate when their rectal temperatures were raised to  $106^{\circ}$  or higher. These disturbances in temperature regulation revealed by exposure to heat and cold persisted for many weeks, as long in fact as the experiments were continued.

ran subnormal temperatures for several weeks unless kept in a very warm room (8). That the hypothermia was less prolonged in the cat is explained in part at least by the protection afforded by its thick fur.

Cats (7) and monkeys (8) with bilateral lesions in the preoptic and supraoptic regions or in the anterior part of the lateral hypothalamus often develop high temperatures shortly after the operation. This is illustrated in *Fig. 5*. In this cat, while under ether anesthesia, lesions were placed on each side in the anterolateral part of the hypothalamus. After stopping the an-

esthetic a continuous record was taken of the postoperative rectal temperature. Half an hour after the operation the temperature began to rise rapidly and it reached  $106.8^{\circ}$  in  $4\frac{1}{2}$  hours. At that time 14 mg. of nembutal per kilogram of body weight was given intravenously and the temperature fell sharply to  $102.8^{\circ}$ . As the effects of the nembutal wore off the temperature rose reaching  $106.2^{\circ}$  some 11 hours later, showing that the nembutal had interrupted an otherwise continuing hyperthermia. During the rising phases of the curve shivering was observed.

The neural mechanism which prevents overheating includes the region above and in front of the optic chiasma which is specifically responsive to heat, and a pathway leading backward from this responsive region through the lateral hypothalamus. Destruction of the principal part of this region prevents the cat from panting when its rectal temperature is raised to  $106^{\circ}$ . On the other hand, large lesions in front of the anterior commissure or removal of the frontal lobe did not have this effect. The anterior limit of the area concerned with heat loss activity, as determined by the effect of lesions coincides very closely with the limit as determined by local heating of the brain.

Since medially placed lesions behind the optic chiasma or at the level of the mammillary body do not prevent panting, the descending pathway from the heat sensitive region above and in front of the optic chiasma does not run backward through the medial part of the hypothalamus. On the contrary it runs backward through the lateral part of the hypothalamus and is interrupted by either anterolaterally or posterolaterally placed lesions.

Although medially placed lesions in the hypothalamus behind the optic chiasma, or even extending forward

above the posterior border of the chiasma, do not prevent panting, they cause an increase in the threshold for panting; *i.e.*, the body temperature rises on the average one or two degrees higher before panting begins. This rise in panting level may perhaps be due to damage to that part of the heat-sensitive region which is situated behind the chiasma. This caudal part of the heat-sensitive region is obviously less important for temperature regulation than the part located in the preoptic and supraoptic regions, because it is less sensitive to direct heating and because, when it is damaged panting is not abolished although its threshold may be raised, and because although it remains intact, panting can be abolished by more anteriorly or laterally placed lesions.

It must not be supposed that the heat-sensitive region, the chief part of which we have found to be located in the preoptic and supraoptic regions, represents a motor coordinating center controlling panting. But it is connected by a descending pathway in the lateral hypothalamus with such a motor center which is located somewhere behind the hypothalamus. This motor center is still capable of functioning after the heat-sensitive center has been cut away. It is well known that, immediately following decerebration through the caudal part of the hypothalamus, this motor panting center is freed from cortical inhibition, and decerebrate panting may occur although the body temperature is subnormal.

The neural mechanism which protects against chilling is not seriously impaired by moderate sized lesions in the hypothalamus unless these are bilateral and are located in the caudal part of the lateral hypothalamus. Very large lesions anywhere in the hypothalamus cause a loss of ability to keep the body temperature up to normal and

this loss is more pronounced when the lesions are caudally placed. We interpret these observations as meaning that the neurons concerned in heat conservation are distributed through a large part of the hypothalamus and are in part identical with those which cause vasoconstriction and piloerection. The fact that the chief efferent sympathetic path from the hypothalamus lies lateral to the mammillary bodies in the region, the destruction of which causes marked impairment in temperature regulation, fits perfectly with this conception (9).

Hypothermia and hyperthermia are convenient terms to use in designating a condition of abnormally low or abnormally high body temperature when environmental temperature is within the usual comfortable range. Hyperthermia with rectal temperatures of  $105^{\circ}$ ,  $106^{\circ}$  or  $107^{\circ}$  was fairly commonly encountered in cats (7) and monkeys (8) within a few hours following the placing of lesions in the preoptic and supraoptic regions or in the anterior part of the lateral hypothalamus. The temperature did not as a rule remain high for more than one or two days and the condition was rarely fatal. The lesions in the animals which developed hyperthermia were so placed as to injure the region specifically sensitive to heat, or the descending path from this region, and to leave largely intact the part of the hypothalamus responsible for heat production and heat conservation. That the lesions caused an excitation of the heat production mechanism was evidenced by the shivering which occurred during the rising phase of the temperature curve in some of our cats. From these facts we may conclude that neurogenic hyperthermia is due to an excitation of the heat production and heat conservation mechanism accompanied by an impairment of the heat loss mechanism. The logical method of combating the fever would be to reduce

the activity of the irritated hypothalamic centers. This was accomplished in cats by the intravenous injection of nembutal with surprisingly rapid reduction of temperature.

As a result of the experiments on cats we have reached the conclusion that the center at the base of the brain which serves for the control of body temperature is composed of two parts. A heat-sensitive region is located chiefly in the preoptic and supraoptic regions and connected through a descending pathway in the lateral hypothalamus with a motor center for panting located somewhere behind the hypothalamus. This part serves to increase the rate of heat loss. The other part which serves to reduce heat loss and probably also to increase heat production seems to be coextensive with the sympathetic center in the hypothalamus. Its descending pathway enters the brain stem dorsolateral to the mammillary bodies. Bilaterally symmetrical lesions situated dorsolateral to the mammillary bodies interrupt the descending pathway from both parts and cause a loss of ability to regulate the temperature in either direction.

The question may be raised how far are the conclusions reached as a result of this investigation applicable to man. In the first place it must be recognized that, while the processes involved in heat production and heat conservation are essentially alike in the cat and man, the processes involved in heat loss are different. Man with his hairless skin and abundant sweat glands is able to lose heat rapidly through the skin; but the cat depends on panting and the evaporation of water from the tongue, mouth and respiratory passages. It sweats only on the pads of the feet. Because of this difference in the peripheral mechanism of heat loss it is not safe to assume that the central control is the same in the two forms. More

work needs to be done on the monkey which sweats but does not pant.

Nevertheless, some indication that the center controlling heat loss may have a location in the monkey similar to that in the cat, is that in the monkey just as in the cat lesions in the anterior part of the lateral hypothalamus cause hyperthermia.

There are better reasons for the belief that the center which protects against chilling has the same location in primates as in carnivores. In the first place the peripheral mechanism is alike. In the second place it is known that in monkeys as in the cat the lesions which cause the greatest loss in ability to prevent chilling are located in the caudal part of the lateral hypothalamus (8). A mechanism which is alike in the cat and monkey is not likely to be greatly different in man.

Clinicians know that extensive damage to the hypothalamus, such as is sometimes produced by tumors, causes subnormal body temperature. But autopsy findings in such cases have revealed diffuse lesions, which are not well placed for an analysis of the problem of temperature regulation. An instructive case was reported by Davison and Selby (4). During the patient's stay in the hospital he had a consistently low temperature. During the greater part of one month the temperature remained at about 92.4°. At autopsy an angioma was found which largely destroyed the hypothalamus. In the figure representing a section through the anterior part of the mammillary bodies, these bodies can scarcely be recognized; and it is stated that the lateral hypothalamic nucleus was destroyed. In a section through the caudal part of the mammillary bodies "the same changes were noted as in the preceding sections, except that both mammillary bodies were easily identified at this level". This extensive damage to

the hypothalamus, extending far enough back to destroy the lateral hypothalamic area at the level of the mammillary bodies was, we believe, the cause of the hypothermia.

Two very instructive cases of a different kind have been reported by Alpers (1). In both cases operations on suprasellar tumors were followed by rapidly developing hyperthermia and death. In both cases there was extensive destruction of the gray matter surrounding the third ventricle behind the optic chiasma. These cases show that this part of the hypothalamus cannot be responsible for heat production and conservation or else its destruction would have caused a fall instead of a rise in temperature. On the basis of the evidence furnished by the experiments on cats and monkeys, by the hypothermic patient reported by Davison and Selby and by Alpers' two cases of hyperthermia we may safely conclude that the same part of the hypothalamus protects the body against chilling in carnivores and primates.

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# ALTERATIONS IN THE HYPOTHALAMUS IN MENTAL DEFICIENCY

L. O. MORGAN, PH.D.\*

**PATHOLOGIC** changes in the hypothalamus in idiopathic epilepsy, and a group of psychoses have been previously described (19, 20, 21). Earlier literature dealing with the relationship of pathology in the hypothalamus to various nervous and mental abnormalities was reviewed in these papers. From the clinical aspects Singer (23), Sakel (22), and Alpers (1), have emphasized the importance of the central vegetative mechanisms with reference to mental and emotional disorders.

Other investigators (2, 37, 8, 9, 10, 12, 13, 14, 16, 18, 24) relate disturbances of fat, carbohydrate, potassium, iron, phosphorus, and oxygen metabolism, temperature regulation, blood volume and circulation time, and abnormal allergic reactions to schizophrenia and in some cases to other types of mental and emotional disorders. These investigations indicate that there may be some fundamental vegetative imbalance underlying many of the so-called "functional" disorders of the central nervous system.

These observations suggest the possibility that the central vegetative mechanisms may be defective in mental deficiency, especially in that large portion of cases whose condition cannot be ascribed to localized disease or injury in the cerebral cortex. Furthermore, a study of the hypothalamus in mental deficiency may throw some light upon the more fundamental problem concerning the extent, if any to which an intact hypothalamus is essential for

the normal development and function of the organism.

## MATERIALS AND METHODS

The material for the present study consists of the diencephalon from 16 brains of institutional cases of mental deficiency. 13 cases were obtained from the Newark (N. Y.) State School through the courtesy of the late Dr. C. L. Vaux, superintendent, and Dr. E. A. Baumgartner, pathologist. 3 cases (cases 5, 6 and 13) were obtained from the Wrentham (Mass.) State School through the courtesy of Dr. C. S. Raymond, superintendent and Dr. C. E. Benda, director of research. An attempt was made to select, as far as possible, a representative group of cases, excluding only those which gave evidence of disease or injury which had directly damaged the cerebral cortex.

These specimens were embedded in celloidin, sectioned 35 micra in thickness and stained by the modified iron-hematoxylin method. The 16 brains from defective patients were compared with 6 "apparently normal" brains which were used as controls. Over 100 brains in our collection which had been used for previous studies of the hypothalamus served as additional control material in so far as they were found to aid in interpreting the changes noted in mental deficiency.

Cell loss in the nucleus supraopticus (basal optic ganglion), nucleus paraventricularis, nucleus tuberis lateralis, and substantia grisea was determined by counting the cells in two or more representative microscopical fields in

\* From The Department of Anatomy, University of Cincinnati, College of Medicine, Cincinnati, Ohio.

each nucleus and comparing this with the average number of cells found in corresponding areas in the 6 control brains. Because of the irregular and diffuse distribution of the cells in the nucleus tubero-mammillaris it was necessary to substitute a method of "strip counting". Two rectangular areas extending across the nucleus from medial to lateral side at a level immediately in front of the mammillary bodies were used. The thickness of each section was estimated and any necessary corrections made for variations in the thickness of the sections.

The amount of chromatolysis was estimated in each nucleus and more general pathologic alterations noted.

#### DESCRIPTION OF CASES

*Case 1:* The patient was a white female, 9 years of age. She was admitted to the Newark State School 16 months prior to death. There was a history of meningitis at the age of 6 months. A peculiarity was noted at that time. She walked at 3 years and talked very little at the age of 7 years. Upon admission to the school at the age of 7 years and 9 months the patient showed a mental age of 1 year, 8.4 months, with an I.Q. of 21.9. Her physical development was 2 years below normal. She was a typical mongolian idiot. The patient was indolent, apathetic, resistive and at times negativistic. There were indications of glandular dysfunction. Death was due to tuberculous pneumonia. At autopsy the brain weighed 1000 grams and showed no gross abnormalities.

*Case 2:* The patient was a white male, 6 years of age. He was admitted to the Newark State School 2 months prior to death. The patient gave a history of appearing abnormal at birth. He began teething after the first year and began walking at the age of 3. At the age of 5 years, 11 months he showed a mental age of 1 year, 11.6 months with an I.Q. of 33. He was a short, underdeveloped boy, with poor muscular coordination. The genitalia were infantile. The patient presented the typical mongolian

characteristics. He was mentally inaccessible, negativistic, and stubborn. Death was due to an interventricular septal defect of the heart. At autopsy the brain weighed 1125 grams and showed no gross abnormalities.

*Case 3:* The patient was a white female, 28 years of age. She was admitted to the Newark State School 1 year prior to death. The patient was born with jaundice. She fell out of bed at age of 5 months and her head was drawn backward  $4\frac{1}{2}$  years after this. She walked at 3 years and talked at 4. On admission at the age of 27 years she showed a mental age of 3 years, 6 months with an I.Q. of 21. She was 4 feet, 8 inches in height, and weighed 96 pounds. Facial conformation and hands were characteristic of the mongolian idiot. Insight and judgment were lacking but she was good-natured and cooperative. The patient died of bronchopneumonia. At autopsy the brain weighed 1050 grams and showed no gross abnormalities.

*Case 4:* The patient was a white male, 9 years of age. He was admitted to the Newark State School 3 years prior to death. The history stated that the mental peculiarity was noted at the age of 3 months. He was given endocrine treatment at the age of 3 years. The first dentition was late. He walked and talked at 3 years. He became very active and destructive at about 3 years of age. On admission at the age of 5 years and 9 months the patient showed a mental age of 1 year, 9.6 months with an I.Q. of 31. He was a typical mongolian type. He was a cryptorchid. Mentally the patient was practically inaccessible. He was lively, active and agreeable with others. The patient died suddenly from an unknown cause. Autopsy revealed an interventricular defect of the heart. The brain weighed 1150 grams with no gross abnormalities.

*Case 5:* The patient was a white male, 20 years of age. He was admitted to the Wrentham State School 2 years prior to death. The history states that during pregnancy the mother worried constantly from domestic trouble, experienced severe fright from an explosion and also at the sight of

her husband being bitten by a dog. The child was always listless and did not cry. First teeth appeared at 2 years of age. He talked at 5 and walked at 7. Upon admission at the age of 17 years, 11 months he showed a mental age of 1 year, 9 months, with an I.Q. of 11. The patient was a fairly well developed and well nourished individual, 5 feet 3½ inches in height and weighed 110 pounds. He was classified as a typical mongolian idiot. The patient died of bronchopneumonia. The autopsy revealed small, descended testicles. The sella turcica was open leaving the hypophysis exposed. The brain weighed 1295 grams, was rather hard in consistency, but showed no gross abnormalities.

*Case 6:* The patient was a white male, 14 years of age. He was admitted to the Wrentham State School 7 years prior to death. The mother was of low grade mentality. The child slept most of the time until he was 4 years of age. He walked at the age of 1 year, 2 months and had his first teeth at the age of 2 years. At the age of 7 years, 2 months his mental age was 2 years, with an I.Q. of 28. He was fairly well developed and nourished, weighed 43 pounds and was 3 feet, 6 inches in height. He possessed the physical characteristics of mongolism. He was very dull and easily startled. The patient died of bronchopneumonia. At autopsy the thyroid was small. There was hyperplasia of the thymus, thyroid and testicles. The calvarium was 8 mm. in thickness over the temporal lobe. The brain weighed 1100 grams. The convolutions were broad and not very numerous.

*Case 7:* The patient was a white female, 44 years of age. She was admitted to the Newark State School 27 years prior to death. At the chronological age of 34 her mental age was 2 years with an I.Q. of 15. At the age of 17 the patient was diagnosed as a mongoloid. At the age of 34 she was reclassified as a cretin idiot. She was, at the latter date, 4 feet in height and weighed 72 pounds. The head was small, the face ape-like in expression, the tongue thickened and the thyroid atrophic. The hands were broad with stubby fingers, the skin thick

and wrinkled, and the abdomen pendulous. The patient died of lobar pneumonia. At autopsy the brain showed no gross abnormalities.

*Case 8:* The patient was a white male, 39 years of age. He was admitted to the Newark State School 10 months prior to death. The history states that he was pulled out of bed by another child at the age of 4 months. This was believed to have been followed by meningitis. He was considered the brightest child in the family until 4 months of age. He then became stuporous and retarded in all ways. He walked at 5 or 6 years of age and reached the fourth grade in school at the age of 14 or 15. He sang well and played the piano by ear. Upon admission at the age of 38 years and 11 months the patient showed a mental age of 6 years and 6 months with an I.Q. of 40.6. The patient was slender, poorly nourished and poorly developed. His orientation was good but insight and judgment were lacking. He was dull, apathetic and extremely slow to respond, if at all. Death was due to bronchopneumonia. At autopsy the brain weighed 1510 grams, and showed no gross abnormalities.

*Case 9:* The patient was a white female, 44 years of age. She was admitted to the Newark State School 18 years prior to death. She was an illegitimate child, developed slowly and walked and talked at age of 4. Upon admission at the age of 26 years she showed a mental age of 3 years, 6 months with an I.Q. of 22. She was 54 inches in height and weighed 80 pounds. She could not answer questions, appeared foolish, laughed most of the time and was child-like in habits, conduct, and disposition. The patient died of influenza with lobar pneumonia. The autopsy showed a colloid goiter with firm enlargement of the middle lobe of the thyroid. The brain showed some dilatation of the posterior horns which contained grayish, flocculent fluid.

*Case 10:* The patient was a white female, 22 years of age. She was admitted to the Newark State School 7 years prior to death. The patient had whooping cough as

a baby and pneumonia in early childhood. She attended school at the age of 5 and reached the fourth grade at the age of 15 years. She was subject to epilepsy which was confined to rather severe night attacks. Upon admission at the age of 15 she showed a mental age of 9 years and 6 months with an I.Q. of 56. Comprehension and judg-

a few months of age. He walked at the age of 2½ years but never talked. He pounded his head against the floor or wall. He was classified as an idiot. He was 51½ inches in height and weighed 65 pounds. Cause of death was not stated. The autopsy revealed an erysipelas of the scalp, contusions of right cheek and nose; chronic

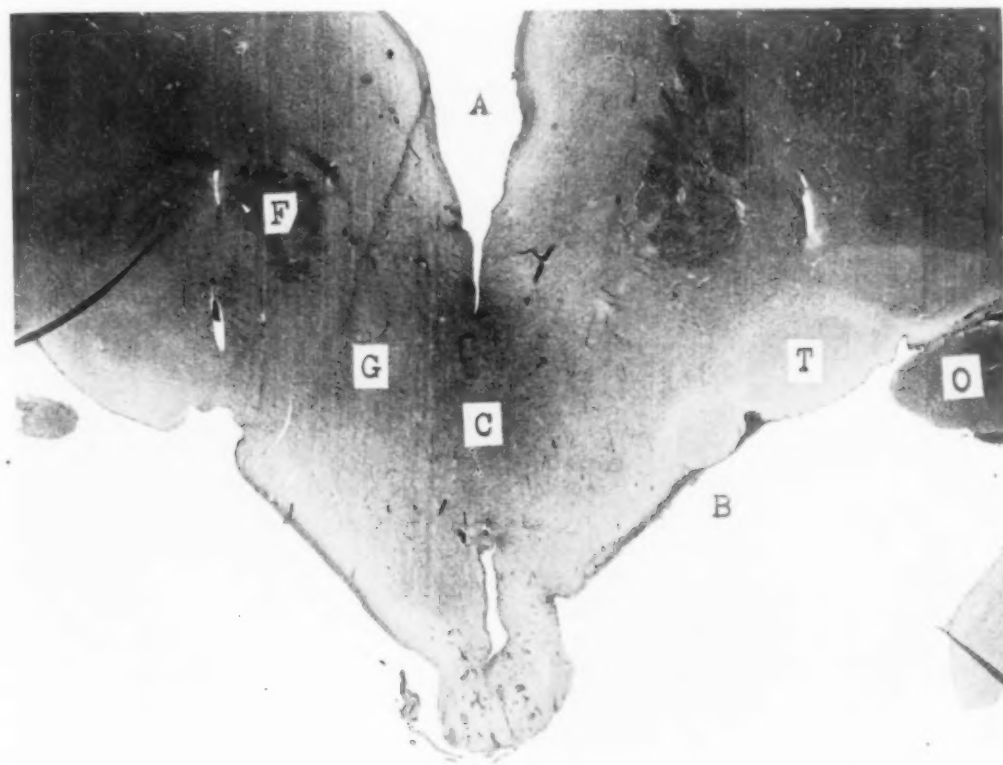


FIG. 1. Section through the posterior hypothalamus in case 9. F., fornix; G., substantia grisea; T., nucleus tuberculi lateralis; O., optic tract. Note the subependymal gliosis at A., the fusion of the hypothalamus across the third ventricle at C., and the infiltration of reactive cells in the pia mater at B.

ment were of the fourth degree. Memory, attention and prolonged thought control were defective. The ideation field was limited and monotonous. She was emotionally unstable. She was 5 feet 3 inches in height and weighed 110 pounds. The patient died of acute, diffuse tuberculosis. At autopsy the brain weighed 1325 grams and showed no gross abnormalities.

*Case 11:* The patient was a white male, 15 years of age. He was admitted to the Newark State School 1 year prior to death. His mental defectiveness was apparent at

meningitis, chronic fibrous pleurisy. The brain weighed 1475 grams. The pituitary was small.

*Case 12:* The patient was a white male, 25 years of age. He was admitted to the Wrentham State School 9 years prior to death. He presented a history of having walked at 18 months but did not talk distinctly until 5 years of age, and had his first teeth at 1 year. He was peculiar and backward from birth, slow to take notice of things, required more help than most children, had very poor memory, and was



inclined to be seclusive and emotionally unstable. Upon admission to the school at the age of 16 years he showed a mental age of 8 years with an I.Q. of 50. He was 5 feet, 4½ inches in height and weighed 144 pounds. The ears were set close to the head and simple in pattern and the head

was rather large and round, weighing 0.6 gram.

*Case 13:* The patient was a white female, 37 years of age. She was admitted to the Newark State School 23 years prior to death. At the age of 25 her mental age was

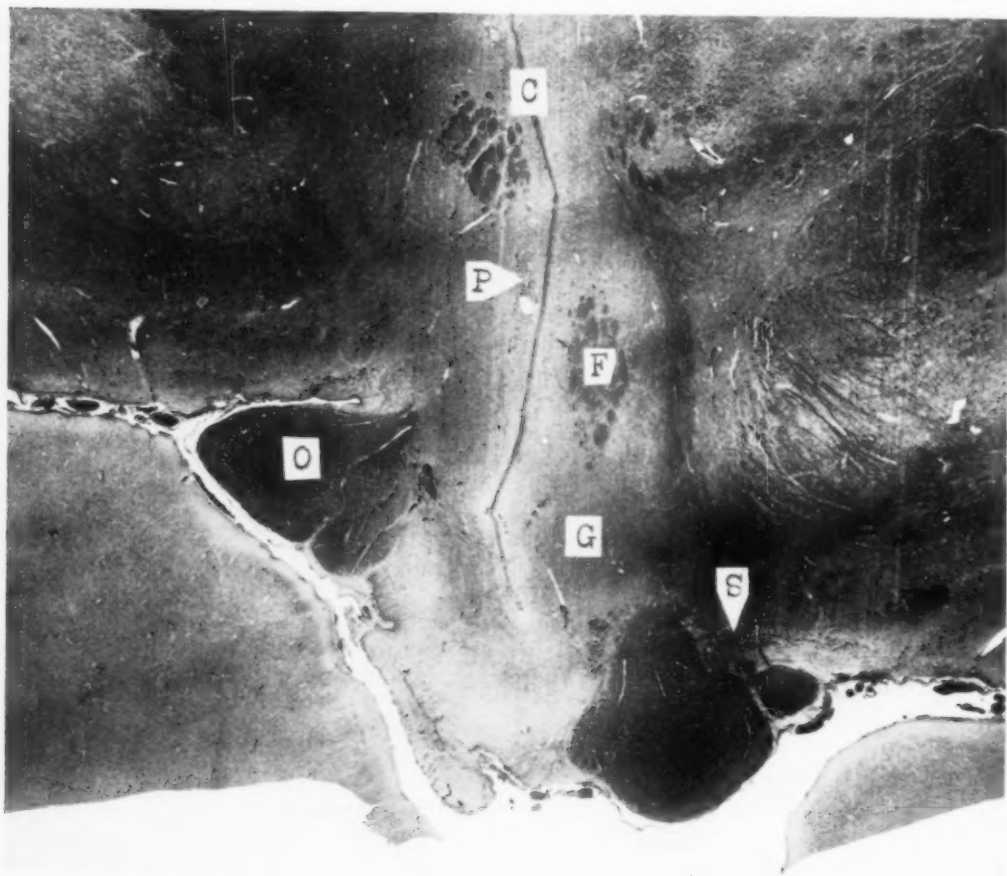


FIG. 2. Section through the anterior hypothalamus in case 16. O., optic tract; F., fornix; P., paraventricular nucleus; G., substantia grisea; S., supraoptic nucleus. Note the compression and distortion of the third ventricle (C.) and the fusion of the ependyma in some areas.

measurements were somewhat larger than normal. The patient was quiet, rather stupid, untidy, and nervous. The cause of death was chronic nephritis and uremia. Autopsy showed one small testicle descended. The calvarium was very thick (7 mm. at the temporal lobe, 9 mm. at occipital). The brain weighed 1400 grams and seemed to be better developed on the right side than on the left. The pituitary

7 years, 6 months with an I.Q. of 47. She was physically normal. She reached the 5A grade in school and could read and write quite well. She was pleasant and polite and used good language. She was simple and knew absolutely nothing outside of institutional affairs. She became maniacal at the end and died in stupor. The autopsy showed chronic endocarditis, mitral and slight aortic and tricuspid stenosis. The

brain was normal to gross examination.

*Case 14:* The patient was a white male, 5 years of age. He was admitted to the Newark State School 2 days prior to death. The patient gave a history of having weighed 3 $\frac{3}{4}$  pounds at birth, and his first tooth at eight months and started talking at 14 months. He was in the hospital for three months at 7 months of age with a high fever which left him with spasticity accompanied by many uncoordinated movements. At the age of 5 years and 9 months the patient showed a mental age of 3 $\frac{1}{2}$  years with an I.Q. of 60. The patient was handicapped by spastic paraplegia. He was a small, poorly nourished child, 3 feet in height and weighed 31 pounds. The patient died of lobar pneumonia. The autopsy showed a chronic fibrous meningitis. The skull was very thin, and the cerebrospinal fluid increased in amount. The brain weighed 1425 grams.

*Case 15:* The patient was a white male, 6 years of age. He was admitted to the Newark State School 7 months prior to death. Upon admission at the age of 5 years and 7 months he showed a mental age of 1 year, 2.4 months with an I.Q. of 21. He was a poorly developed and nourished boy, 35 inches in height and weighed 29 lbs. The head was hydrocephalic. He was a double cryptorchid with sparse hair, pigeon breast, flaring ribs and mal-occlusion of the jaws. He was mentally inaccessible, and could not walk or talk. The patient died of gastro-enteritis. Autopsy showed an enormously enlarged skull with bones quite thin. There was a chronic meningitis. The cerebral spinal fluid was markedly increased in amount. The brain weighed 1375 grams. The ventricles were all dilated. The pituitary appeared small.

*Case 16:* The patient was a white female, 8 years of age. She was admitted to the Newark State School 3 years prior to death. There was a history of the child having appeared normal, healthy and bright until an attack of whooping cough at the age of 14 months. On the tenth day of the whooping cough the patient had a choking spell and became black and rigid. Following this she would beat her head

against the chair, she gradually lost her speech, the control of the bowels and the arms and legs grew weak and thin. Her whooping cough was also accompanied by convulsions which did not persist. Upon admission at the age of 4 years and 11 months the patient showed a mental age of 7 $\frac{1}{2}$  months with an I.Q. of 12.7. She was 17 pounds underweight, the face was short and broad, the ears large lobed, the palate narrowed anteriorly, the thorax was broad and the skin was smooth and fine. She possessed heavy hair, wide eyes and a vacant grin. The head was microcephalic with a cephalic index of 759. The condition was ascribed to probable cerebral hemorrhage complicating several paroxysms during attack of whooping cough. The patient died of acute bronchitis with lobar pneumonia. At autopsy the brain weighed 850 grams. There was chronic fibrous meningitis. No gross abnormalities of the brain were apparent.

#### GENERAL PATHOLOGY

Sections through the diencephalon in this series of brains reveal a great variety of pathologic alterations, some of which cannot be properly evaluated without the use of special techniques. The changes which are summarized below include only those which were apparent in sections stained with the routine iron-hematoxylin technique. I am indebted to Dr. A. R. Vonderahe for the data which forms the basis for this resume of general pathology.

A striking feature in all but 3 of the 16 cases studied was the abnormal shape and contour of the third ventricle. In case 15 (hydrocephalic) the ventricle was dilated and distorted in shape. In 12 of the remaining cases (2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, and 16) the ventricle was compressed inwardly, bringing the walls into close approximation. In case 7 the walls of the ventricle were fused posteriorly, while in cases 9 and 16 there was fusion in a large area at the level of the infundibulum. In case 9 the ependyma was ob-

literated in the center of this fused area allowing the hypothalamus to become continuous across the mid-line. In some cases the ventricle was compressed throughout its extent. Frequently, however, the walls were approximated in some areas and not in others, giving peculiar hour-glass, dumb-bell, or club-shape contours to the ventricle. The approximated walls of the ventricle were often thrown into a curved, S-shape, or wavy line. Our observations suggested that abnormal pressure factors may be involved in the majority of the cases studied.

There was evidence of chronic leptomeningitis of varying degrees in 6 cases (1, 5, 7, 11, 12, and 15). This was characterized by the proliferation of fibroblasts, and endothelial cells with the presence of macrophages and sometimes of lymphocytes. Three additional cases (2, 4, and 9) showed some infiltration of reactive cells into the arachnoid membrane. There was definite subependymal proliferation of glia in the third ventricle in 11 cases (4, 5, 6, 7, 8, 9, 12, 13, 14, 15, and 16). In only 2 cases (3, and 10) both the ependyma of the third ventricle and the meninges at the base of the brain were normal in appearance. In the remaining 14 cases either one or both of these membranes showed evidence of pathologic involvement.

Vascular congestion was present in the hypothalamic area in cases 3, 9, and 11. Subependymal hemorrhage appeared in case 15. The perivascular spaces were enlarged in case 5 and were infiltrated with round cells in case 12.

There was apparently some fiber degeneration in the fornix in cases 2, 5 and 7, in the internal capsule in cases 7, 8 and 10 and in the optic tract in cases 14 and 16. The fornix seemed to take a paler stain than usual in cases 1, 4, 9, 13, and 16.

In view of the frequency with which

anomalies, and anatomical defects appear elsewhere in the body in mental deficiency, it is interesting to note that no clear-cut anomalies appeared in the diencephalon in any of the cases used for this study.

#### THE HYPOTHALAMIC NUCLEI

With one exception (nucleus tubero-mammillaris) a reduction in the number of cells was consistently found in all of the hypothalamic nuclei. In the majority of cases the cell counts for the nucleus tubero-mammillaris were considerably higher than for the control group. In case 10 there was a cell loss in this nucleus of 32 per cent while only 48 per cent of the remaining cells were normal in appearance. It is interesting to note that this patient was an epileptic and the appearance of the nucleus tubero-mammillaris in this case was typical of that previously described for epilepsy. Case 15 which was hydrocephalic with marked interventricular pressure gave a cell count which was only slightly less than the lower ranges of the control group.

A very striking feature in most of these cases was the normal appearance of the cells in the nuclei of the hypothalamus. Based upon data obtained from a study of over one hundred brains it is considered that less than 10 per cent of chromatolytic cells is not significant for the paraventricular and supraoptic nucleus and the substantia grisea while as much as 15 per cent chromatolysis in the nucleus tuberis lateralis is commonly found in cases of death from a great variety of causes. With the exception of cases 1, 11, 14 and 15, there was not a significant amount of chromatolysis in any of the cell groups of the hypothalamus. The chromatolysis existing in these cases could perhaps be ascribed to the acute encephalitis and meningitis in case 1, to the chronic meningitis in cases 11 and 14, and to the inter-

ventricular pressure (hydrocephalus) which was present in case 15. The absence of active cell degeneration in the remaining cases indicates that the defects which were present in the hypothalamus appeared at some earlier period in the patient's history and were not the result of conditions existing immediately prior to death.

*Nucleus paraventricularis*: Cell counts (see table) showed a marked defect in

sized cells. In the remaining mongoloid cases there was an absence of the large cells with an additional reduction in the number of small and medium-sized cells. In the remaining 10 cases there was a tendency for the large cells of this nucleus to survive while the defect was chiefly confined to the small and medium-sized cells.

*Nucleus supraopticus*: Cell counts in the nucleus supraopticus (basal optic

TABLE SUMMARIZING THE CELL REDUCTION AND DEGENERATIVE CHANGES IN THE HYPOTHALAMIC NUCLEI; N INDICATES NORMAL

Case No.	N. Paraventricularis		N. Supraopticus		N. Tubercis Lateralis		Substantia Grisea		Age	Sex	I.Q.	Classification
	% cell loss	% normal cells	% cell loss	% normal cells	% cell loss	% normal cells	% cell loss	% normal cells				
1	50	80	60	72	62	80	58	52	9	F	21.9	Mongolian
2	28	N.	37	N.	60	74	24	N.	6	M	33	Mongolian
3	28	N.	39	N.	56	N.	32	N.	28	F	21	Mongolian
4	27	N.	18	N.	29	N.	24	N.	9	M	23	Mongolian
5	54	N.	40	N.	56	N.	26	N.	20	M	11	Mongolian
6	44	N.	25	N.	58	N.	27	N.	14	M	28	Mongolian
7	40	N.	40	N.	45	N.	23	N.	43	F	15	Cretin?
8	40	N.	37	N.	56	N.	28	N.	39	M	40.6	Unclassified
9	40	N.	38	N.	56	N.	30	N.	44	F	22	Unclassified
10	33	N.	13	N.	53	N.	32	N.	22	F	56	Unclassified
11	45	84	32	N.	46	N.	38	86	15	M		Idiot
12	44	N.	34	N.	44	N.	23	N.	25	M	50	Unclassified
13	34	N.	N.	N.	33	N.	30	N.	37	F	47	Unclassified
14	61	64	34	56	68	N.	47	N.	5	M	60	Unclassified
15	58	55	43	68	74	53	75	N.	6	M	21	Hydrocephalic
16	50	N.	26	N.	52	N.	21	N.	8	F	12.7	Microcephalic
Aver.	41		35		52		33					

this nucleus in every case studied. The cell reduction ranged from 27 per cent in case 4 to 61 per cent in case 14. The average amount of cell loss was 41 per cent for the entire group of cases.

Perhaps it is of some significance that in the 6 mongoloid cases the largest cells of the paraventricular nucleus were almost or entirely absent. In cases 2, 3, and 4, the cell reduction was confined almost if not entirely to these large cells. The amount of cell reduction in these cases showed a remarkable similarity and approximates rather closely the normal proportion of large cells to the small and medium

ganglion) showed a reduction in the number of cells in all except one case (case 13). In the 15 cases in which this nucleus was defective the cell reduction ranged from 13 to 60 per cent. The average amount of cell loss for the group was 35 per cent.

*Nucleus tubercis lateralis*: This nucleus was defective in all the cases studied and was affected to a greater degree than any other cell group. The amount of cell reduction ranged from 29 per cent in case 4 to 74 per cent in case 15 (hydrocephalus). The average amount of cell reduction for the entire group of cases was 52 per cent.



*Substantia grisea:* This nucleus was involved less than any of the three preceding cell groups. The amount of cell reduction ranged from 21 per cent in case 16, to 75 per cent in case 15. The greatest destruction occurred in the four atypical cases (cases 1, 11, 14 and 15) in which a chronic or acute condition existed which caused additional cell destruction prior to death. Excluding these cases the greatest amount of cell loss was 32 per cent and the average for this remaining group was 27 per cent as contrasted with an average of 33 per cent for the group as a whole. The affect of these atypical cases upon the remaining nuclei was not nearly so pronounced as for the substantia grisea.

#### DISCUSSION

The characteristics of mental deficiency have been extensively reviewed by Berry and Gordon (6), Tredgold (25), and others. In the majority of defectives many organs and tissues, or the body generally, are marred by a great variety of anatomical defects. There is also widespread physiological inadequacy and disturbances of physiological function. According to Tredgold the life-history of most defectives can be summed up as "*defective vitality of both body and mind*". Their circulation is poor, their temperature-regulating mechanism is imperfect, metabolism is defective, and their assimilation is so defective that, in spite of an abundance of wholesome food, many of them remain small, stunted, and ill nourished. There is frequent irregularity and delay in the development of the endocrine glands. Their physiological margin, and powers of resistance are so reduced that they are prone to contract disease, and such disease quickly prove fatal. These defects tend to occur more frequently and to be more pronounced in the lower grades of mental deficiency.

The mental defective is conspicuously lacking in the power of reasoning and judgment; in the ability to compare, discriminate, and relate objects, ideas or experiences. The instinctive tendencies with their associated feelings, and primary emotions are, as a rule, weaker than in the normal. The same is true of the more complex emotions. Still more marked is the inability to organize the emotions to form the sentiments which should dominate personality. In action the defective is stereotyped and without originality.

Berry and Gordon point out that the infra-granular cortex is about three times more extensive in man than in the anthropoids. The supra-granular cortex, of which only rudiments exist in the anthropoids, reaches its highest development in man. In the higher grade mental defectives the supra-granular layer alone may be deficient while in the low grade defectives the infra-granular layer and sometimes other levels of the nervous system are also involved.

Benda (4) produced evidence to show that there is a disorder in the proliferation and ossification of the cartilaginous bones in mongolism. There is an early arrest in the development of the base of the skull, resulting in an abnormal position and configuration of the base of the orbits which, according to Benda, accounts for the peculiar shape and appearance of the skull in mongolism. Benda (5) also described changes in the thyroid gland in mongolism which resembled the changes seen in cases of pituitary disease and the parenchymatous hyperplasia produced experimentally by the administration of the so-called thyrotrophic hormone derived from the anterior lobe of the pituitary. He suggests that a temporary hyperthyroidism during the prenatal period is a cornerstone on which rests the explanation of mongolism.

From the above summary it appears

that the majority of mental defectives present a picture of extensive functional inadequacy coupled with defective growth and development. This suggests a basic vegetative dysfunction with extensive involvement in particular of the autonomic and endocrine systems. From this point of view the widespread involvement of the vegetative centers of the hypothalamus which are described in this paper may be of considerable significance.

The evidence concerning the functions of the hypothalamus has been reviewed by Fulton (11), Masserman (17), Ingram (15), and others. This evidence as yet does not permit us to ascribe specific functions to the individual nuclei with any degree of certainty. In general it may be said that the anterior hypothalamus is concerned chiefly with growth and nutrition, and with the accumulation and conservation of energy. These functions are probably mediated, to a large degree at least, through the influence of the anterior nuclei upon the parasympathetic nervous system and upon the pituitary. The posterior hypothalamus is chiefly concerned with the mobilization and discharge of energy. These functions are probably mediated, to a large degree at least, through the influence of the posterior nuclei upon the sympathetic nervous system and upon the adrenal and thyroid glands. There is some indication that the nucleus tubero-mammillaris which is not involved in mental deficiency, is concerned with the regulation of the general body metabolism, hence exerting a particularly strong influence upon the thyroid gland. It is interesting to note therefore that Benda considers the changes occurring in the thyroid in mongolism to be secondary to pituitary involvement.

In the 16 cases of mental deficiency which we have studied there is marked cell reduction in the substantia grisea

and the nucleus tuberis lateralis in every case. The nucleus tuberis lateralis is the most affected of any of the nuclei studied while the substantia grisea is least affected. A previous study of idiopathic epilepsy and a group of psychoses (19, 20, 21) showed the direct opposite of this relationship, the substantia grisea being more severely damaged than the nucleus tuberis lateralis. However, these were institutional cases, most of which at least, showed deterioration. These nuclei were also found to be involved in a series of 15 miscellaneous cases of early psychoses (unpublished data), but to a much milder degree and with more variation in pattern. The fact that these two nuclei are affected in epilepsy and the psychoses as well as in mental deficiency seems to indicate that the substantia grisea and the nucleus tuberis lateralis play an important role in making possible normal mental and emotional activity. An analysis of these cases indicates further that the phylogenetically old substantia grisea is particularly concerned with activity on the instinctive emotional level, while the more recently acquired tuberis lateralis is more essential for those activities commonly associated with intelligence. This interpretation is supported by the fact that the nucleus tuberis lateralis is most involved in the mental defective whose deficiency is more pronounced in the field of intelligence. The less marked emotional inadequacy of the defective also corresponds to the lesser degree of defect in the substantia grisea as compared with that of the nucleus tuberis lateralis.

In the anterior hypothalamus the nucleus paraventricularis is affected to a marked degree in every case while the nucleus supraopticus is involved in all but one case. The fact that these nuclei are not affected in the psychoses indicates that they are concerned with

some defect which is present in mental deficiency but not usually present in the psychoses. The effect of the anterior hypothalamus upon the hypophysis and the parasympathetic nervous system and its influence upon carbohydrate, fat, and water metabolism, and upon growth and nutrition in general suggests that some or all of these functions may be altered as a result of the defect in the paraventricular, and supraoptic nuclei.

There is no constant direct relationship between the amount of hypothalamic injury and the degree of mental deficiency. However we cannot draw conclusions from this fact without more complete knowledge concerning the time factor. Since mental deficiency appears during a period of rapid growth and development it is probable, for example, that a retardation of growth and a nutritional and functional inadequacy occurring during the foetal period would result in a greater deficiency than a similar defect which appeared later during infancy or childhood.

The 6 cases of mongolism, and a majority of the remaining cases included in this study could, on the basis of the case history, no doubt be classified as "primary amentia". Mental deficiency of this type is commonly ascribed to a defect in the germ plasm. The absence of developmental anomalies in the third ventricle region in these cases is very striking. On the other hand evidence of pathologic changes occurs with sufficient regularity to suggest that toxic, and infectious conditions, and mechanical injury may play an important role in many cases of so-called "primary amentia". The present study indicates a need for further investigation on the etiology of "primary amentia".

We lack conclusive evidence that the alterations found in the hypothalamus constitute the primary causative factor

in mental deficiency. However the evidence suggests that the hypothalamus plays an important role in the etiology of mental deficiency with regard to both the somatic, and the mental abnormalities which are so commonly associated with this condition.

#### ABSTRACT

A histologic study was made of the diencephalon in 16 cases of mental deficiency, cases which did not show evidence of disease or injury to the cerebral cortex, and most of which at least could be classified as "primary amentia".

Pathologic involvement of the third ventricle region was evident in all but 2 cases. Ependymitis and meningitis, and distortion of the walls of the third ventricle were the most common findings.

The nucleus tubero-mammillaris was the only cell group in the hypothalamus which did not show a marked reduction in the number of cells. There was an average cell reduction of 27 per cent for the paraventricular nucleus. In 15 cases the supraoptic nucleus showed an average cell loss of 35 per cent. The nucleus tuberis lateralis showed an average cell loss of 52 per cent. The average amount of cell reduction for the substantia grisea was 33 per cent.

The normal appearance of the cells in the hypothalamic nuclei suggests that the cell reduction occurred at an earlier period in the history of the patients.

Through its influence upon the hypophysis and the parasympathetic nervous system the anterior hypothalamus is probably concerned chiefly with growth, nutrition and the conservation of energy. The posterior hypothalamus through the suprarenals, thyroids, and sympathetic nervous system is probably concerned with the mobilization and discharge of energy. Hence it is believed that the alteration in the hypothalamus may play a role in the widespread physiological inadequacy and the abnormalities of growth and development, which are so common in mental deficiency.

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## RORSCHACH MANIFESTATIONS OF IMPROVEMENT IN INSULIN TREATED SCHIZOPHRENICS\*

ZYGMUNT PIOTROWSKI, PH.D.\*\*

THE INTENSIVE physiological processes set in motion by the introduction of insulin into the organism lead, in a considerable percentage of schizophrenics, to marked personality changes. Since these changes frequently appear within a relatively short space of time, the psychological study of schizophrenics treated with insulin is a most interesting one. The effect of insulin treatment varies in the individual case. Moreover, all personality traits do not change to the same extent, many of them, indeed, undergoing no change at all. Hence, the problem of discriminating the variable personality traits from those which are relatively permanent has assumed importance in the study of the schizophrenic personality. The question arises whether the Rorschach method can aid in the differentiation between variable and permanent traits and whether this differentiation can be demonstrated in an experimental manner.

The investigation of insulin treated schizophrenics sheds light upon another important problem, namely, that of evaluating the unexploited personality potentialities, for insulin treatment, if successful, appears to induce the patient to utilize his potentialities in a fuller measure. The Rorschach evidence at least justifies the opinion that the chances for, and the degree of, improvement after insulin therapy are the better, the less the schizophrenic's per-

sonality has deviated from the norm and the greater the discrepancy between the actual and the potential functioning of the patient's personality. When the patient is making full use of whatever mental capacities he still possesses, insulin treatment does not seem to benefit him. Thus predictions of personality adjustment will be rendered more valuable when we are ready to make valid estimates of unexploited mental capacities. This is a point which the clinician constantly keeps in mind but concerning which little mention is made in experimental personality research.

The psychological implications of insulin therapy are of especial importance to the Rorschach investigator. Work with insulin treated schizophrenics not only furnishes him with a wealth of material for the evaluation of the extent to which the Rorschach findings compare with the behavior of the patients, but it also forces him to pay attention to many important details of the Rorschach method which do not, at present, permit of quantitative treatment and which are little discussed in the Rorschach literature. Among these hardly explored problems of the Rorschach method is the discovery of signs which would permit us to learn whether or not there is room for improvement in the mental functioning of the subject.

The following conclusions are based on a study which is being carried out at the New York State Psychiatric Institute and Hospital. A group of 60 schizophrenic patients was examined with the Rorschach method before insulin

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\*\* From the Department of Psychiatry, Columbia University.

treatment and was retested shortly after the termination of insulin treatment. The pre-treatment record of each patient was compared with his post-treatment record. The purpose of this communication is to describe a number of qualitative differences between the pre-treatment and the post-treatment Rorschach records—differences which accompany improvement in the patients' mental condition.

The differences between the pre-treatment records and the post-treatment records ranged from very significant to very insignificant ones. It is important to note that patients whom the medical staff declared unimproved did not, as a rule, show significant differences between the pre- and the post-treatment records, while those who improved greatly or recovered showed noticeable differences (2). On the whole the differences between the pre- and the post-treatment Rorschach records paralleled the differences in improvement as observed clinically. Comparisons between Rorschach findings and clinical observations are possible with regard to such traits as perseveration, capacity for prolonged voluntary attention, approximate degree of manifest anxiety, agitation, impulsive emotional reactions, emotional lability, nature of dominant attitude, whether it is one of resignation or self-assertion, quality of mental production, conscious control over the thought processes, coherence of reasoning, and so forth.

The improvement after successful insulin treatment is manifested in the Rorschach record in a variety of ways:

- 1) First of all, there is a significant improvement in the speed and ease with which interpretations are given. After successful treatment, the patient shows less hesitation, more self-assurance, and is less circumstantial and more to the point, omitting the fanciful elaboration of ideas that we find so fre-

quently in the pre-treatment records. In the great majority of cases, the average time per response is shorter.

- 2) Not only the verbal form but also the logical content of the responses undergoes a definite change for the better. One of the peculiarities of a schizophrenic Rorschach record is a combination of actual interpretations of the inkblots with mere descriptions of them. The normal subject does not confound interpretations with descriptions apparently because he is able to distinguish between the relevant and the irrelevant. In the post-treatment records of improved schizophrenics we find significantly less of such confusion.

- 3) A third important difference between the pre- and the post-treatment findings is the increase in the number and quality of movement responses. These responses have been found to represent mental productivity, the individual's capacity for inner life. They are more numerous in the post-treatment records, indicating the presence of a more active inner life.

- 4) Another significant difference is the increase in the number and percentage of the form-color responses in the post-treatment records. These responses are very important for social adjustment because they bear a close correlation with the capacity for good and effortless emotional contact.

- 5) Of very great importance is the increase in the percentage of sharply perceived forms, *i.e.*, an increase in interpretations which fit their respective inkblots adequately. This change implies that the patient's conscious control over his thought processes, the adequacy of his ideas and his prolonged voluntary attention have improved.

- 6) A clear distinction should always be made between the percept and its elaboration, especially when dealing with psychotics. By percept is meant

the visual image which the patient projects into the inkblot and by elaboration all the fantasy material associated with this basic percept. In all recovered or much improved schizophrenics the percepts undergo a marked change for the better. This change noted in the Rorschach records of improved schizophrenics reflects the marked shift in the trend of their thought and in the nature of their associations. It is generally true of all subjects, normal and psychotic, that a deep personality change brings about a corresponding change in the percepts of these subjects. The differentiation between the percept and its elaboration is particularly important for purposes of prognosis. My experience has led me to believe that good percepts warrant a good prognosis regardless of their elaboration. From the prognostic standpoint, it seems to matter little whether the patient refrains from any elaboration or whether he elaborates the percepts profusely and fantastically. In fact, reasonable elaborations based on vague percepts are indications of poorer prognosis than far-fetched elaborations based on good percepts. The percept, then, may be regarded as being of primary importance whereas the thoughts expressed in the fantasies and in the elaboration of the percepts are undoubtedly of secondary importance and are much more variable.

7) The ability to combine felicitously the various details of the inkblots into more meaningful wholes improves in some patients. This would correspond to an improvement in constructive thinking. Here, for example, is the response of one patient, a young woman of superior intelligence, to card III before insulin treatment: "Let me see if I can think . . . Two stilted figures (referring to the side blacks) . . . if they were two women who could be gossiping about another woman . . . It has

. . . to me it's humorous. They're taking a cauldron (dark low center) in the middle, they are middle class women. You can see the two are in love (refers to middle red), they're smoking to each other, piping spirits (top red)." This patient responded in the following manner to the same card after treatment: "I think I mentioned before that this looks like two figures bent over what might be a cauldron. There is fire (the red blots suggesting fireplaces in the kitchen). Two grotesque figures with a strong bend or inclination of the feet over what would represent a cauldron. The figures look something like chefs. You can envisage big white aprons spread on each of them, voluminously spread (referring to the white space between the 'arms' and the 'legs' of the figures). The white and dark contrasting look like chefs in white aprons. They have vests above and pants . . . I guess that's about all". We see, thus, that the patient reacted after treatment not only to the red and black portions of the inkblot, as she had done before treatment, but that she also incorporated the white space into her response. Furthermore, the integration of the details is better in the post-treatment record than it had been in the pre-treatment record.

It must be emphasized that not every improved patient shows all of these changes in his post-treatment record. However, at least several of these changes can be found in the post-treatment record of every improved patient.

Summarizing the differences, we find that the post-treatment records reveal a greater logical coherence in the patients' mental production as well as a broadening of the patients' personalities, indicating that those patients who do improve after treatment have a more co-ordinated and more constructive inner life and are more capable of

making a good emotional adjustment than they had been before treatment. Hence, we have, in the Rorschach method, an instrument by means of which we can record objectively some of the changes which take place in the schizophrenic personality following in sulin treatment.

#### CASE STUDIES

In order to give a more definite idea of the manner in which improvement following successful insulin therapy of schizophrenics is manifested in the Rorschach method, the pre-treatment and the post-treatment Rorschach records of two male patients are presented. These patients were matched with regard to physique, intelligence, and socio-economic as well as racial and religious background. They were of similar bodily structure, being tall and long limbed. Both young men were considered ungainly, with thick lips and pasty, acneous complexions. Both were born in New York City, into families of moderate circumstances, and both received their early education in the city public schools.

The similarity in their pre-psychotic personalities is striking. Early development was essentially normal. Both were over-protected by their mothers and were docile and obedient children, seclusiveness being a prominent characteristic of each patient. There were no temper tantrums or other behavior difficulties in infancy. Their general intelligence was superior, as was their school achievement prior to the onset of the psychosis. In both cases the first marked symptoms of abnormality were noted about one year before admission to the New York State Psychiatric Institute. Of these two patients, one is considered to have recovered from schizophrenia, while the other has shown no improvement.

*The Recovered Case:* The patient, 23 years of age, is the younger of two children. His sister, who is three years his senior, is married and has always been an active and energetic person. When the patient was 5 years of age, his mother was hospitalized for three months because of a manic episode. The patient started school at 6 years and made unusually rapid progress. Miss Gladys Tallman tested him when he was 8 years 2 months old; his Stanford-Binet mental age was found to be 13 years 3 months with a corresponding IQ of 162. At that time, the school considered him extremely bright but very slow in response and lacking in muscular coordination. It was said of him that "his answer was always right, always the best, but he was the last to turn his paper in." He was not interested in playing but was always busy solving problems. He would lie on the floor for hours at a time working on mathematical problems. He also liked to spend a great deal of time reading. He had the reputation of having a marked sense of justice and fair play. The patient was awarded a scholarship to a special high school of high scholastic standing, where he made excellent progress. However, when he was 15½ years old, he was removed from this school by the authorities because he constantly annoyed the girls. At that time, he had a tendency to fondle his sister. At 17, he graduated from a public high school with honors. At 21, he graduated from college. Throughout his college life he made no close friends. He did not like dancing. The movies held no attraction for him. He did not seek the company of women, habitually going to bed at nine o'clock in the evening. After graduation, his family aided him in securing the position of filing clerk with one of the important New York newspapers. During this period, he made oc-



casional attempts at forming friendships with young women, but his efforts proved unavailing. He hated his job but continued to work at it. His ambition was to become a writer, and two months before admission to the hospital, several of his articles were printed by a newspaper with a high reputation.

The onset of his illness was accompanied by a marked and sudden change in behavior. Several months before admission he changed from a quiet and pleasant fellow worker into a very resentful and irritable individual with unexpected outbursts of temper. After a time, he refused to go to work, complaining of insomnia. He began to spend the better part of the day in bed, claiming that he had influenza. His attitude toward his mother also underwent a radical change; he accused her of being neglectful of him and of having dominated him throughout his life. He became very voluble, expressing bizarre opinions on all subjects. He talked a great deal about the improvements which he could make in such divergent fields as the war in Spain and treatment of mental diseases. He continued boastful and excitable. He was convinced that it was necessary for him to breathe fresh air and would frequently go to the window in order to inhale. He spent a great deal of time telephoning to his female casual acquaintances. He formed the habit of writing long and incoherent letters. He showed no desire to return to work.

Upon admission to the hospital, he was restless and over-talkative, referring to himself as a great writer. However he was rather agreeable and cooperative in carrying out the ward routine. Gradually, he became less talkative, more preoccupied, mumbling to himself incoherently, and began to express fears that the other patients were spying on him. In spite of the in-

creased suspiciousness the patient continued to be cooperative as far as the hospital routine was concerned and at times was quite pleasant. He assumed a superior attitude toward the other patients, became more irritable and belligerent on the verbal level. He did not attack any one although he threatened to do so many a time. In his brief impulsive outbursts he pounded on doors and tables or threw small objects out of the window. He was generally hyperactive, talking or muttering to himself most of the time. His moodiness manifested itself chiefly by sudden irritability which at times led to assaultiveness.

The diagnosis of dementia praecox, paranoid type, was made by the medical staff. A marked improvement was noted immediately after the termination of insulin therapy. A check-up thirteen months later revealed that the patient had continued to improve to such an extent that he could be considered recovered.

*Pre-Treatment Rorschach Record:* The patient's responses were not recorded verbatim because at times he spoke too rapidly and at other times interspersed his responses with a great many exclamations, some of which were nonsensical. Occasionally, the patient muttered remarks under his breath. It is believed, however, that the record contains all the interpretations proper. The series of dots indicate moments when the patient talked rapidly or indistinctly. There were rather long pauses between responses. All personal names mentioned by the patient have been changed. The apex of the signs,  $\wedge \vee$  -  $< >$ , represents the top of the card, the last sign of each series indicating the position of the card at the moment the response was given. Beck's system of identifying the various details of the inkblots (1) pp. 205-214 has been used in all records.

C. A.: 23 yrs. 7 m.

Time: 30 minutes.

Location		Responses	Scoring	
I				
Whole	^	Most likely an inkblot. Could be made any way. Could be a negative and a positive. This is a positive.		
D 16		1. This might be a woman in the center with very buxom figure.	D F+	h
Ds 15		2. These probably are perforations in paper.	S F+	hole
Whole		3. This reminds me of a bird in flight but it doesn't resemble any bird I ever saw.	W FM+	a
D 16		It looks like a woman in the center, buxom figure.		
Whole		4. I can tell what that would be, a bat.	W F+	a P
II				
Whole	^ V < V	All right. Well, also an inkblot.		
Ds 20	^ V	1. Well, apparently a hole torn in the paper. Well, almost anything.	S F+	hole
D 24	^ V	2. This seems to be a funny gag. Professor Fitzgerald talking on the subject of mental hygiene work.	D M-	h O
Ds 20		3. A female womb.	S F+	sex
III				
D 1	^ V	1. Akron slug. A gorilla, a tough guy. Gorilla warfare. Next!	W M+	h P
IV				
Whole	^ V	1. Hm. This is somebody. Guess who!	W F+	h
	^	Cannot tell. (Sings at the top of his voice:) Gladys, come here! Mickie, come on and make love. . . . Certainly not Santa Claus.		
	V	Nobody that I remember . . . (rapid stream of words in different languages, chiefly in French). Oh, that's a thing that the French would use to scare people. I don't scare easily. (Exclaims:) Raymond W. Davies, Psychology II.		
V				
Whole	^ V	1. This is really something interesting, a bird in flight. This is not an American bird, is it? That reminds me of a French bird that we studied in Biology II. It is a hybrid between an Australian fishhawk and a wallaby.	W FM+	a
VI				
	^ V	I can interpret everything . . . I'll give the exam.		

<i>Location</i>	<i>Responses</i>	<i>Scoring</i>
D 12	1. Some wing, that something.	D F+ ad
Whole	2. Oh sure, a hide stretched out to be dried. A buffalo hide. I've not gone into the hide industry. Betty Heinberger. Reaction time.	W Fc+ a P

## VII

Whole	^ V	1. Oh sure, the Russian ballet. They have a place near the reservoir. Tennis place. When I went to school on 34th Street, there was—there was a girl named Dorothy Dutton in the class . . . On the roof they gave some performance . . . Appalachian Mountain view equipment. (Patient asked what he means) ^ Yes and no . . . but don't quote me. I've an idea.	W M+ h
Whole		2. This reminds me of Miss Rambotton from Ann Arbor. I have not seen her in that position but I've heard stories about her.	W F+ sex O

## VIII

Whole?	^ V	1. Kentucky gentlemen . . . .	W F- h O
D 3	^	If I knew . . . "A Skeleton in the Family Closet" by John Merrit. ^	
D 10	>	2. Here goes a wolf.	D FM+ a P
	<	Here goes another. On an inkblot it looks alike on both sides.	
D 3	^	3. This is vertebrae.	D F+ at P
		Gladys, Joan. (Sings:) The ring is on my head, the ring is on my brow. There is more in this picture than you think.	
top edge of blue	V	4. Rim of pine trees. Pioneer village, that's my idea. Me and John Lindenberg. . . . There was a cowboy!	d F+ pl O
		Louise Vogel. Is she a good dancer? Yes! Is she a good tennis player? Yes, excellent! . . . I understand.	

## IX

D 8	^ V	1. There is something. Green reminds me of the police force.	D C abst
D 27		2. Pink, reminds me of my reputation as the leading pink at college. I wasn't red, I wasn't conservative. When I made a speech at college, if it was good, I listened . . . Looks to me like an inkblot. Let me analyze, as the boys say. Gladys! (Shouts:) Come on and make love!	D C abst
Whole			
D 17		3. Let me analyze this further. Like a spinal cord. Like Doctor Jones gives spinal cords. It hurts me and I bet it hurts anybody else more.	D F- at

Location	Responses	Scoring
X		
D 4	$\wedge > \vee \wedge \vee$ 1. Now there is something. Yah, fiddler crabs, and blue.	D F+ a P
D 15	2. A fake doubledinger bird. (Speaks of birds, fowls, "Bronx birds," etc. volubly) I go into my song trance. (Sings)	D F- a O
	$< \vee$ Were you ever arrested? I was in all sorts of jails and under my real name . . . All sorts of birds, beasts, animals (general remark). There is a lot in the picture of the fiddler crab.	

In most instances the scoring presents no difficulties. The figures were seen in the usual way unless there is a remark to the contrary. In I-1 the patient was particularly impressed by the rounded black detail protruding into the upper white space, which he interpreted as breasts. In II-2 the right half was meant but the patient was unable to point out any details except the top where the head would be. It was also impossible to persuade the patient to explain his interpretation in detail in IV-1. He made it clear, however, that he perceived IV-1 as a human figure. In VII-2 the patient perceived the whole inkblot as the front view of the

hips and lower extremities of a woman; the patient demonstrated with his hands that the legs were spread apart. It was impossible to obtain any information concerning VIII-1; it is probable that the patient meant the whole inkblot.

*Post-Treatment Rorschach Record:* This record has been taken verbatim. The figures in the time column indicate the number of seconds elapsing between the presentation of the card to the subject and the beginning of the statement following each time marking. Dashes are used to indicate lengthier pauses made by the patient.

C. A.: 24 yrs. 0 m.

Time: 14 minutes.

Location	Time	Responses	Scoring
I			
Whole	1	$\wedge$ 1. Bat.	W FM+ a P
D 16	15	$\vee < \wedge$ 2. And the center part looks like the silhouette of a woman.	D F+ h
	64	That's all.	
II			
Whole	11	$\wedge$ 1. Looks like—two witches.	W MC+ h
	105	$> \vee < \wedge \vee \wedge < > \wedge$ (Shakes head) I can't get much else out of it.	
III			
D 1	5	$\wedge \vee$ 1. An orchestra leader seen behind.	W M+ h
D 1	26	$\wedge$ 2. And this way like two men holding up a pot between them.	W M+ h P
	90	$> \wedge \vee \wedge < \wedge \vee < \vee$ (Hands card in without a word.)	



<i>Location</i>	<i>Time</i>		<i>Responses</i>	<i>Scoring</i>
IV				
W minus D 8	3	$\wedge$	1. Like a bear skin.	D Fc+ a P
D 5	43	$\vee \wedge \vee > \wedge$	2. And this part is shaped like a foot.	D F+ hd
D 3	51		3. And the top part is shaped like a ram's horn.	D F+ ad
V				
Whole	22	$\wedge \vee \wedge \vee > \vee$	1. Slightly like a butterfly.	W FM+ a P
	27		That's about all.	
Whole	36	$\wedge$	2. Oh no! I also see something like a swallow with its wings spread.	W FM+ a
VI				
Whole	4	$\wedge$	1. Well, this too looks like a skin spread out, animal skin.	W Fc+ a P
	25		And the line down the center like the animal's backbone.	
	56		That's all.	
VII				
Whole	6	$\wedge \vee$	1. Like a pair of Russian dancers.— They're hitched together.	W M+ h
D 3+5	24	$\wedge$	2. Like a bust, a torso of two women arguing with each other.	D M+ hd P
	74	$\vee \wedge > \wedge$	(Hands card in)	
VIII				
D 1	10	$\wedge$	1. The top part looks like the head of an animal swimming.	D FM+ ad
D 3	23		2. Lower down it looks like the vertebrae of an animal.	D F+ at
D 10	35		3. And the two pink spots look like wolves.	D FM+ a P
	76	$\vee < \wedge$	(Hands card in)	
IX				
Dr 13	9	$\wedge \vee$	1. The pink looks like a ram's head.	d F- ad O
Drs 15	33	$> \vee$	2. And the center part like a pair of owl's eyes.	S F+ ad
	72	$< \vee > \wedge \vee \wedge >$	(Hands card in)	
X				
D 4	4	$\wedge$	1. The blue looks like crabs.	D F+ a P
D 14	22	$< \wedge$	2. And the green here looks like caterpillars.	D FC+ a P
D 19+5 +7+15	83		3. And the whole center portion looks like the man's skeleton.	D F- at O

During the inquiry following the examination proper the patient volunteered some additional remarks elaborating his interpretations. The most

important of these remarks have been recorded below. Everything which is not in parentheses was said by the patient.

I. (Bat) The whole effect; as seen from the top while flying. (Woman) I can't see the woman herself but I see the outline of the dress; (did not notice transparency) now that you showed me these could be her legs, right here.—II. (Witches) It was the orange color that made me think of the witches, the orange head; it looks as if they were arguing with each other, face to face; they have their hands opposed to each other as in a fight.—III. (Orchestra leader) This looks like the back of an orchestra leader with arms above his head before they started the piece. (Men) I visualized them in full dress suits, tuxedos; and they got this thing here (D 15) and they're raising it from the ground.—IV. (Foot) Like a shoe rather than the bare foot.—V. (Butterfly) More as if it were posed on something with wings, standing up, holding balance; as I look at it more carefully, it does not resemble a butterfly very well. (Swallow) I imagine it in flight and with its tail forked out, gliding rather than flying.—VI. (Skin) I couldn't think of any particular animal; I see the two, four legs, without this tail part (D 4). (Hav-

ing handed in card VI during the test proper, the patient said that it was difficult for him to see as many things as he had seen during the first, i.e., the pre-treatment, examination).—VII. (Dancers) This is the only thing that I thought was dynamic, that had motion in it; ballet dancers with big hats, with backs against each other for just this moment.—VIII. (Animal head) The lines sort of going back and out. (Wolves) They look as though they were prowling and following some tracks.—IX. (Ram's head) With big curls, facing you. (Owl's eyes) These slits would be where the owl's eyes are.—X. (Caterpillars) These look like the green tree caterpillars. (Skeleton: D 14 is legs; D 7 is pelvic girdle; D 5 is wish-bone; D 19 is the breast and neck bones) —Now I am more conscious of the fact that these are inkblots and that all resemblances are of necessity remote. (Taking another look at card II, patient said, pointing to Ds 20:) It could be the woman's pelvis, here in the outline. (Patient remarked that he did not enjoy the inkblots now as much as he had before)

## PRE-TREATMENT RORSCHACH RECORD TABULATION:

No. Resp.	23	W	9(1-)	M	3(1-)	a	7
Time	30'	D	10(3-)	FM	3	ad	1
T/R	1.31'	d	1	{F	14(3-)	h	6
		S	3	{Fc	1	at	2
F+%	80			C	2	pl	1
(F+FM)+%	83					hole	2
a%	35					sex	2
Pop.	6					abs	2
Orig.	5(3-)						

## POST-TREATMENT RORSCHACH RECORD TABULATION:

No. Resp.	21	W	8	M	4	a	8
Time	14'	D	11(1-)	MC	1	ad	4
T/R	.67'	d	1(1-)	FM	5(1-)	h	5
		S	1	{F	8(1-)	hd	2
F+%	90			{Fc	2	at	2
(F+FM)+%	87			FC	1		
a%	57						
Pop.	9						
Orig.	2(2-)						

*Comparison:* The post-treatment record unquestionably points to a much more efficient functioning of the patient's personality than does the pre-treatment record. The improvement is manifested by a number of Rorschach components. Rorschach's monograph (3) contains the best explanation of the psychological meaning of these components.

a) The percentage of sharply perceived forms has increased significantly.

b) There is a great change in the distribution of color responses. The two pure color and abstract responses are not repeated but a good form-color response appears in their stead.

c) The human movement responses have not only increased in number but have also improved in quality.

d) The ratio of movement responses to color responses, the M:C, has shifted considerably in the direction of the movement responses. This finding, together with the change in the color responses and the improved F+%, indicates a much greater emotional control and stability.

e) The number of popular responses has increased, while the number of original responses has decreased, implying a greater participation in the common trends of thought. This is also indicated by the increased percentage of responses with animal content.

f) An obvious improvement is shown by the absence of incoherent and fanciful free associations. The patient now interprets the inkblots calmly, having conscious control over his thought processes. The pre-treatment interpretations had been produced automatically with little conscious control on the part of the patient. The whole tone of the post-treatment record has become more refined.

g) There are no descriptive com-

ments in the post-treatment record. The responses consist only of interpretations.

h) The improvement is also shown in the capacity to combine intelligently areas of different shapes and colors into one interpretation. In card II, both the black and the red areas are used in one interpretation; again, in card X, the color and the form are combined in the "green caterpillars" response.

i) The percepts have changed greatly. Only 30 per cent of the pre-treatment percepts are repeated in the post-treatment record. Likewise, only 33 per cent of the post-treatment percepts occur in the pre-treatment record. One does not find such very low percentages of percept recurrence unless the subject's personality has undergone a marked change. In themselves, these low percentages do not let us know whether the personality change has been one for the better or for the worse. Other Rorschach components must be analyzed in order to determine the direction of the personality change.

There are, then, marked differences between the pre- and the post-treatment records of this schizophrenic who recovered after insulin therapy.

*The Unimproved Case:* The patient, 15½ years old, is the only child of his father's second marriage. There are two step-sisters, one 30 and the other 28 years old, of the father's previous marriage. The elder step-sister has been married for a number of years. The younger one has been suffering from idiopathic epilepsy for more than ten years, and when the patient was 8 years old, she was committed to a state institution. The father's sudden death of a heart attack, which was witnessed by the patient three months prior to his admission to the Psychiatric Institute, made a deep impression upon the patient. The death appeared unreal to

the boy and he still wonders at times whether his father is dead. The mother, who is now in poor physical health, has always been a nervous and quarrelsome individual. The patient's development had been normal up to the thirteenth year of his life. The only conspicuous trait was his seclusiveness, his unwillingness to play with other children. He enjoyed playing the violin and listening to music. He spent a considerable portion of his time reading. His only other recreation consisted of attending the movies. Having always been one of the best students in his class and having made rapid progress in school, he was liked by his teachers. The patient never showed any interest in girls.

The onset of the disease was rather sudden and was marked by uncontrollable outbursts of temper, directed against the mother. This was accompanied by a gradual loss of interest in everything. For this reason, the patient left high school in his fifth term, at the age of 14½ years. His intelligence was tested when he was 14 years 9 months old. The tests were not reliable because the boy was somewhat confused; he obtained a Stanford-Binet IQ of 97 and an Army Alpha IQ of 113. His native intelligence was classified as superior on the basis of his school achievement and the relatively good test results obtained under a handicap. Since the onset of his

disease, the patient has felt very uncomfortable whenever he thought that people were observing him; on one occasion he believed himself to be followed by a man and was severely frightened. It also seemed to him that attempts were made to hypnotize him. As his illness progressed, he lost the capacity to concentrate and to read. His outbursts were usually followed by periods of compunction. His temper, however, grew gradually worse, finally endangering his mother's safety.

During the initial period of his hospital residence the patient was seclusive. After a few weeks he became friendly and rather sociable. In occupational therapy he showed a certain degree of spontaneous interest and worked without requiring prodding.

The diagnosis of dementia praecox, simple type, was made by the medical staff. The patient did not improve after insulin treatment. A check-up four months after the termination of the treatment revealed no change in the patient's personality.

*Pre-Treatment Rorschach Record:* The record is, for the most part, verbatim. On several occasions the patient turned toward the examiner and made brief conversational remarks which were not recorded in order not to embarrass the patient needlessly. The time is in minutes and seconds.

C. A.: 15 yrs. 6 m.

Time: 36 minutes.

Location	Time	Responses	Scoring
I			
D 2+Dr 3	21 $\Delta$	1. This looks like two disfigured men facing each other.	d M+    h O
D 1+D 11	32	2. And like, say, two witches.	do F+    hd
Dr 30	1:07	3. Looks like the head of an alligator.	do F+    ad
Dr 7	2:04 $< \Delta > \Delta > \nabla$	4. If you have enough imagination, you can see two heads (of women).	d F+    hd
	3:36 $< \nabla > \nabla \Delta \nabla \Delta < \Delta > \Delta$	Well—	



<i>Location</i>	<i>Time</i>	<i>Responses</i>	<i>Scoring</i>
II			
D	24	11 $\wedge$ 1. This seems to be a very—faces of two dogs facing each other. Sort of in the shading.	D Fc+ ad P
Dr	13	1:06 $\vee \wedge > \wedge$ 2. Something here that looks like a man with very large shoulders, three times as big as his body.	d F- h O
		1:29 Does not look much like anything but—	
		1:48 I guess you have to use your imagination. (Loudly, to himself:) You better use it!	
D 3+Ds	20	2:14 $\vee >$ 3. Looks something like a bird flying.	Sd FM- a
D	14	2:43 $\wedge > \wedge$ 4. Two wild looking heads with hats on them.	D F- ad
		3:31 $\vee < \wedge < \wedge < \vee$ (Puts card away)	
III			
Dr	14	15 $\wedge$ 1. Two odd looking heads.	do F- hd
D	5	28 $\vee$ 2. Two old men.	D F+ hd
D	7	1:12 $\wedge > \vee >$ 3. Looks like some sort of vest.	D F+ o
D 3 minus Dr 9	1:26	4. Two heads, sort of heads of two women.	d F- hd O
D 4, upper half	1:48	$> \vee$ 5. Looks like two hands outstretched.	d m+ hd
D 4, middle jut	2:09	6. Like two moose heads.	d F+ ad O
Dr	12	2:47 $\wedge \vee$ 7. Looks like a map of France.	d F- ggr
		$> \wedge \vee < \vee \wedge \vee <$ (Shrugs shoulders, puts card away)	
		3:34 Pretty poor day for concentration.	
IV			
Dr	14	23 $\wedge \vee \wedge$ 1. That looks something like a butterfly.	D F- a
Darkest of D 7	42	$\vee \wedge$ 2. Something here reminds me of an outline of Africa.	D F+ ggr
		1:08 On second thought it looks more like South America.	
Dr	6	1:56 $> \vee \wedge$ 3. Looks something like the shape of Spain.	d F- ggr O
		2:12 My mind seems to be turning geographical.	
Darkest of D 7	2:47	$\vee \wedge \vee$ 4. Two seals—of the animal kind, not the Christmas seals.	D FM+ a
See below	3:27	5. Faces of two women opposite each other.	d F+ hd
See below	3:52	$> \wedge$ 6. Two small feet on the bottom.	d F+ hd
	4:21	$< \vee$ The last time when I looked at it, I had certain impressions.	
D 7+D 3	4:42	$\wedge$ 7. Seems to be something like two animals standing on their forefeet, with hats, sort of clown hats.	D FM- a O
		5:29 I guess I can call that up.	

<i>Location</i>	<i>Time</i>	<i>Responses</i>	<i>Scoring</i>
V			
D	6 18	$\wedge \vee < 1$ . Looks something like the open bill of a bird.	D F+ ad
D 9+D 1	32	2. The other side looks like the open mouth of a crocodile.	D F+ ad
See below	1:11	$\wedge$ 3. Looks like two dogs facing each other.	d FM- a O
See below	1:54	$\vee$ 4. Looks like the face of a tough looking man with a prominent chin.	d F+ hd O
	2:33	$< \vee >$ (Returns card)	
VI			
D	9 21	$\wedge \vee > < > \vee$ 1. Something that looks like a bear rug.	D Fc+ a P
Dr	10 39	$\wedge$ 2. Looks something like the head of a turtle.	d Fc+ ad
D	3 1:17	$\wedge > \vee$ 3. Bedpost. (Smiles:) Isn't that a crazy idea?	D F+ o
Dr	2 1:38	$< \vee \wedge$ 4. Cat's whiskers.	d F+ ad
D 9 above	2:02	$\vee > \vee$ 5. Two old men with whiskers. Their faces look a little like Santa Claus'.	do F+ hd
Dr 11			
Ends of Dr 11	2:28	6. Heads of two dogs.	D F+ ad
	2:55	$> < \wedge$ (Puts card away)	
VII			
D 3 minus D 1	7	$\wedge$ 1. Faces of two old women.	D F+ hd P
D	5 24	2. Then there seemed to be two heads.	D Fc+ hd
	46	Sort of seem in the shading.	
	54	Seems as though they were made out of snow.	
D 12+D 7	1:41	$\vee \wedge \vee$ 3. This one looks like a butterfly with large wings.	D F+ a
D	1 2:09	$\wedge \vee \wedge$ 4. Looks like two feathers.	d F+ o
	2:27	$\vee \wedge$ (Returns card)	
VIII			
D	10 9	$\wedge \vee \wedge >$ 1. Seem to be two animals resembling the skunk I should say.	D FM+ a P
Inside of D 4+17	34	$< >$ 2. Certain parts here look like the surface of, say, the moon.	d c rock
	58	Sort of rock formation.	
Dr	2 1:21	$\wedge >$ 3. Pen points.	d F+ o
	1:37	$\wedge$ I seem to have a large variety of illusions.	
	1:54	Let's see (examines a detail carefully).	
	2:24	(Puts card away)	
IX			
D	8 14	$\wedge \vee \wedge \vee$ 1. To me it looks like two old men with whiskers.	D F+ hd
Ds	19 1:03	$\wedge < \vee$ 2. Somewhat, it looks like a dress dummy.	S F+ o

<i>Location</i>	<i>Time</i>		<i>Responses</i>	<i>Scoring</i>
D	9	1:31	< 3. It looks like the head of a man with a moustache, with a drooping moustache.	D F+ hd P
		2:25	△ < There seems to be another head there.—They all come in pairs.	
Dr	13	3:01	∇ 4. Something like the heads of two one-eyed monsters staring at each other.	d Fc- ad
		3:42	△ ∇ △ > △ (Puts card away)	
X				
D	3	8	△ 1. Two heads with sort of—the hair on the heads looks like plants, like flowers.	D F- hd
D	7	34	2. These are two birds flying.	D FM+ a
D	5	45	3. Something that looks like a pawnshop sign with one ball missing.	D F+ o
part of D	12	1:22	< △ < 4. The bill of a bird.	d F+ ad
D	6	1:36	> 5. This seems to me like the appearance of a rock formation.	D c rock
D	1	2:27	△ > ∇ △ 6. Looks like the trunk of a tree.	D F+ pl
D	14	2:53	> △ < 7. Looks sort of like two green worms.	D FC+ a
		3:24	△ That's that.	

Only the more important parts of the inquiry following the examination proper are reproduced here. It may be added that the patient cooperated very well and furnished additional explanations of his interpretations when requested to do so easily and gladly. Everything outside of the parentheses was said by the patient.

I. (Men) Looks like they are joined for some reason and have their arms raised to strike each other. (Witches: facing the middle vertical line, with D 11 being part of their floating cloak; this is scored do because usually the entire side is seen as a witch, and not merely the head and upper part of the cloak) (Alligator: scored do because in the vast majority of cases the Alligator includes more than Dr 30)—II. (Dogs) They seem to have their front paws up; if you look at it it's all in the shading, you have to sort of look right into it. (Bird: D 3 is the beak, Ds 20 is the body with outspread wings) (Wild looking

heads) May be the heads of chickens, I don't know.—III. (Vest) Spread out. (Women) It looks as if they were gossiping, with their mouths wide open. (Hands: this is scored because in giving the original interpretation the patient made a gesture indicating that the two hands were pressing down)—IV. (Butterfly) Doesn't seem to have any definite formation but it looks like a butterfly just in here. (Seals) They seem to be looking up in the air. (Faces of women: edge details of D 8 in reversed position; the chin is the highest connecting jut between D8 and D7, the nose is the jut directly above the chin, and the eyes are the usually seen animal eyes; the patient did not mean that the faces are opposite each other but referred to the fact that there are two symmetrical faces on either side of D8) (Small feet: these are the small bottom center projections of D 8) (The "impressions" refer to the patient's first Rorschach record, which he had taken six months be-

fore admission to the hospital) (Animals standing up: each D 7 and D 3 combined is one animal; they are supposed to be facing each other; the D 3 are the clown hats hanging from the back of their heads)—V. (Dogs: D 1 and the light parts of D 9; vaguely seen by the patient) Two dogs facing each other with tall marionette hats on. (Face of man: in reversed position, Dr 4 is the chin, the edge detail above is the nose, and the somewhat lighter round spot above the red is the eye)—VI. (Bedpost: the patient saw the bedpost in the usual manner; his remark that it was a crazy idea was intended to mean that it was crazy to think of a bedpost)—VII. (Butterfly) Looks like

it's put down, pinned down.—VIII. (Skunks) The front paw is uplifted, it looks as if it's going to take a step; might be some action there.—IX. (Man with whiskers: in reversed position; Dr 7 is the beard, stubby top edge extension is the nose) (Monsters) Looks like skulls; the formation, especially the eyes, seems hollow.—X. (Hairy heads) Heads with flower-like hair; would be cartoons of men. (Rock) The different shades show the cracks.

*Post-Treatment Rorschach Record.* The same introductory remarks apply to the post-treatment record as to the pre-treatment record. In general, the patient was a little livelier during the post-treatment examination.

C. A.: 15 yrs. 9 m.

Time: 17 minutes.

Location	Time	Responses	Scoring
I			
D 2+Dr 3	7 ^	1. Well—two distorted men facing each other. The hands are up-raised, one hand is.	d M+ h O
D 1+D 11	44 >	2. Shaped like the map of Africa.	D F- ggr
Dr 30	56 ^	3. Two feet viewed from behind.	do F+ hd O
D 1+D 11	1:15	4. Well, two witch-like sort of objects.	do F+ hd
Dr 7	1:50 > > V 2:23	5. Profile of a face. That's about all—I'm sort of in a fog today. Don't feel very well.	d F+ hd
II			
D 24	5 ^	1. Two faces of dogs—facing each other.	D FM+ ad P
D 14	16	2. And—two heads of sort of a—chickens, rooster.	D F- ad
Dr 13	31	3. And sort of distorted, with large shoulders.	d F- h O
D 3+Ds 20	43 >	4. This gives the appearance of looking down on a bird.	Sd FM- a
	1:06 ^ > ^	That's all.	
III			
Dr 14	7 ^	1. Two sort of distorted faces.	do F- hd
D 7	18	2. Certainly this looks like a vest.	D F+ o
D 4	27	3. Two arms.	D m+ hd
D 3 minus Dr 9	48 > ^ > V	4. Looks sort of like two women laughing.	d M- hd O
	1:16 < ^ >	That's about all.	



<i>Location</i>	<i>Time</i>	<i>Responses</i>	<i>Scoring</i>
<b>IV</b>			
D 7+D 3	28	$\wedge \vee < \wedge$ 1. This looks like two dogs standing on their hind legs wearing sort of long drooping hats.	D FM- a O
See below	1:09	$\vee \wedge$ 2. Looks like two tiny feet on the bottom behind a sort of screen.	d F+ hd
	1:34	That's all.	
<b>V</b>			
D	6	7 $\wedge <$ 1. Sort of a bird with bill open. Sort of jovial expression.	D F+ ad
	56	$\wedge > \vee$ I don't seem to be able to get anything out of it.	
<b>VI</b>			
D	9	6 $\wedge$ 1. That looks like sort of a—bear rug, a bear skin.	D Fc+ a P
Dr	10	25 2. Looks like the head of a turtle.	d Fc+ ad
Dr	2	31 3. Cat's whiskers.	d F+ ad
D	3	36 4. And this, and this looks like a bedpost.	D F+ o
D9 above	59	$> \vee$ 5. This looks like the head of an old man with whiskers.	do F+ hd
Dr 11			
Dr 7, right	1:24	6. I've just noticed something funny. I think it could be the head, like a girl.	d Fc- hd O
Dr 7, left	1:50	7. And the head of a baboon.	d Fc+ ad O
	1:57	That's all.	
<b>VII</b>			
D 3+D 1	7	$\wedge$ 1. The heads of two old women and in the hats they have two feathers.	D F+ hd P
D	5	26 2. Two angry-like faces. They look as if they were made out of snow.	D Fc+ hd
D 12+D 7	45	$>$ 3. This looks like a butterfly.	D F+ a
D	5	55 $\vee$ 4. And we have two elephants.	D F+ ad
	1:08	$<$ That's all.	
<b>VIII</b>			
D	10	11 $\wedge > <$ 1. Seems to be two animals. Don't know exactly what they are, but they're four-legged. Looks sort of hairy.	D FM+ a P
Inside of D 4	28	$\wedge$ 2. Seems that part looks like the moon surface.	d c rock
Dr	6	47 $< > \wedge$ 3. Head of two, well, seems sort of animals.	D F+ ad
Dr	2	59 4. And a pen point.	d F+ o
	1:20	$> \vee \wedge$ (Turns card in silently)	
<b>IX</b>			
Dr	13	8 $\wedge \vee$ 1. Sort of two—looks like skulls—only the eyes show—they seem to be sunken.	d Fc- ad

<i>Location</i>	<i>Time</i>	<i>Responses</i>	<i>Scoring</i>
D	8	1:09 < ^ < ^ 2. The head of a sort of evil looking bearded man. 1:31 V ^ (Turns card in silently)	D F+ hd
X			
D	5	6 ^ 1. At first it looks sort of a pawn-broker sign with one ball missing. I said that twice before.	D F+ o
D	7	36 2. Two bluebirds, I mean in flight.	D FM+ a
D	3	51 3. Sort of odd looking heads with flowers growing out of their hair.	D F- hd
D	1	1:04 4. Tree trunk.	D F+ pl
Brown in D	11	1:16 5. Looks like the head of an Indian.	d Fc+ hd
D	6	1:25 6. Seems to be sort of a rock formation.	D c rock
D	14	1:43 > 7. Looks like two green snakes. 2:13 V < (Shakes head in negative and returns card)	D FC+ a

The following inquiry contains remarks pertaining only to new interpretations.—I. (Feet: human feet, seen from behind, but in such a manner that the left foot is somewhat visible)—II. (Dogs) You would think they're standing on their hind legs. (Bird) It seems to be flying and yet it seems that you are looking down upon it.—III. (Faces: in this, as in the pre-treatment record, the patient could not decide what type of face it was, animal or human) (Arms) Seem to have the palms outstretched, pressing down.—IV. (Tiny feet: same as in pre-treatment record except that the rest of the bottom edge of D 8 is seen as a screen)—V. (Bird) The curve makes it appear as though it were laughing.—VI. (Girl and baboon: the patient was aware of the symmetry of the inkblots and expected to find a counterpart for each detail; the inter-

pretation of baboon following upon that of a girl seemed to be in the nature of a correction rather than a new interpretation; the patient did insist, however, that the right part of Dr 7 is the head of a girl but he was unable to explain how the right and the left parts differed.—VII. (Women: this time the feather-like top detail is included in this interpretation)—VIII. (Animal) They are walking; it looks like a skunk, but no, it's a little too large. (Animal heads) The eyes would be shut.—X. (Bluebirds) I didn't mean bluebirds, I meant the color here is blue. (Snakes: there might be doubt as to whether this is really a form-color answer because it is the only color response in the record, but in contradistinction to the 'bluebirds' the patient said that the color of the snakes "seems to be correct").

## PRE-TREATMENT RORSCHACH RECORD TABULATION:

No. Resp.	50	D	25(4-)	M	1	a	10
Time	36'	d	18(6-)	FM	6(3-)	ad	11
T/R	.72'	do	5(1-)	m	1	h	2
		S	2(1-)	F	34(8-)	hd	15
F+%	77			Fc	5(1-)	pl	1
(F, m, FM)+%	74			c	2	o	6
a%	42			FC	1	ggr	3
Pop	5					rock	2
Orig.	8(5-)						

## POST-TREATMENT RORSCHACH RECORD TABULATION:

No. Resp.	40	D	22(4-)	M	2(1-)	a	7
Time	17'	d	13(3-)	FM	5(2-)	ad	9
T/R	.43'	do	4(2-)	m	1	h	2
		S	1(1-)	F	22(6-)	hd	14
F+%	76			Fc	7(1-)	pl	1
(F, m, FM)+%	74			c	2	o	4
a%	40			FC	1	ggr	1
Pop	4					rock	2
Orig.	7(3-)						

*Comparison:* One need but compare the tabulated data and read the records to see that they do not differ significantly; an analysis of both records leads to the same conclusions regarding the patient's personality. The number of human movement (M) and animal movement (FM) responses has increased but since the new responses are vaguely perceived, they do not affect the conclusions. The somewhat decreased total number of responses and the shorter average time per response cannot be considered psychologically significant because the other, more important, Rorschach components have not changed. Of significance, however, is the fact that only 17% of the percepts found in the post-treatment record are new. Moreover, these percepts do not improve the percentage of sharply perceived forms. In the post-treatment record of the recovered patient, on the other hand, we find 70% of new percepts, nearly all of which are of good quality.

In *conclusion*, I wish to stress a point which seems to be of importance, viz., the fact that there was, before treatment, a marked difference between the recovered and the unimproved patients with respect to their approach to the task of interpreting the inkblots, a difference which disappeared after treatment. The recovered patient had been very inefficient before treatment; he became efficient after treatment. The unimproved patient had already been efficient before treatment; he remained so after treatment. The

recovered patient's pre-treatment inefficient approach, or the great discrepancy between his potential and his actual functioning, can be recognized in his Rorschach record by the following signs: the lack of concentration upon the task and the making of numerous side remarks; the presence of good percepts accompanied by uncontrolled, extensive associations and by a great unevenness of performance; the abnormal distribution of color interpretations, 2 C and o FC, implying a disturbing influence of the emotions upon the reasoning processes. All these signs disappeared after successful insulin therapy. As regards the unimproved patient, on the other hand, his mental efficiency, or, the lack of a noticeable disproportion between his potential and his actual functioning, can be recognized in his Rorschach record by the following: the earnest attempt on the part of the patient to do his best, his elaborations aiming at the completion and clarification of his ideas; the presence of poor percepts combined with controlled elaboration and with an even performance level; the presence of a color response which implies that emotional factors did not interfere noticeably with the functioning of the patient's intellect.

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## PRESENT TRENDS IN THE EVALUATION OF PSYCHIC FACTORS IN DIABETES MELLITUS

A CRITICAL REVIEW OF EXPERIMENTAL, GENERAL MEDICAL AND PSYCHIATRIC LITERATURE OF THE LAST FIVE YEARS\*

GEORGE E. DANIELS, M.D.\*\*

TO ONE INTERESTED IN PSYCHOSOMATIC MEDICINE, three main currents in the literature of diabetes are discernible in the last five years. These emanate from the fields of experimental, general, and psychological medicine. In contributions made by general medicine there are relatively few references to the presence of emotional factors, and when they are made, there is a tendency to minimize their importance. There is even an ebb from the earlier mild interest in the application of the contributions made by the physiologist and biochemist to emotional glycosuria and from the problem of psychic shock as an etiological factor. On the other hand, the few papers contributed by clinicians trained in psychological medicine show an awakened interest and a new approach to this problem. This is due to the systematic scrutiny of somatic diseases—one after the other—by the psychiatrist, and the more penetrating investigation of general diseases made possible by the realization of the importance of unconscious conflict in both functional and structural change.

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\*\* From the Departments of Psychiatry and Medicine, Columbia University, New York, New York.

### FROM THE EXPERIMENTAL FIELD

Through the center of this ebb and flow runs the strong current of recent experimental research initiated and stimulated by the discovery of Houssay and Biasotti in 1929-1930 which has helped to integrate previous isolated experimental and clinical findings, has served to broaden greatly the concept of diabetes, and has given promise of a further understanding of the physiological mechanisms through which emotional influences condition and modify the disease.

Houssay and Biasotti (22, 23) demonstrated that hypophysectomy brings about a marked alleviation of the symptoms of pancreatic diabetes, resulting in the less intense and slower development of the disease. Glycosuria diminishes and may disappear altogether. Sometimes there is no hyperglycemia, and it is even possible to have hypoglycemic crises which improve with the ingestion of sugar. This experimental work done originally on toads and dogs has been performed on many other animals, and the findings have been repeatedly confirmed. It has been further established that the hypophysectomy is equally efficacious whether it is performed before or after the pancreatectomy and that the diabetes returns with full strength with implantation of anterior pituitary gland.

These now classic experiments of Houssay and Biasotti have led to stimulation of a great mass of research and



literature, not only on the part played by the anterior pituitary, but also on the participation of the other endocrines and the nervous system in carbohydrate metabolism. It seems appropriate to review briefly the present status of this experimental work as it cannot help but have a far-reaching effect on our understanding of the mechanisms through which emotional factors may influence or even be responsible, in some cases, for the precipitation of diabetes mellitus in the human being.

*Pituitary:* The hormones affecting metabolism ascribed to the anterior pituitary are rapidly increasing in number. C. N. Long (32) lists nine described at the present time. Houssay mentions, in addition, the blood sugar raising action of extracts of the posterior lobe. It is not yet clear how much overlapping there may be in the action of the substances now described. As this is no place for an extensive discussion of such a very complicated problem, only the broader effects of anterior lobe extracts will be dealt with here.

In addition to the effect of the removal of the anterior pituitary gland in depancreatized animals, Houssay found that not only implants but intraperitoneal injections of crude alkaline extracts of the anterior lobe bring a return of symptoms. The injection of such extract into the normal animal results in the production of hyperglycemia, glycosuria, ketonuria and polyuria on the third or fourth day. These effects begin to disappear after the seventh to tenth day with the continued administration of the same dose (23, 48). Young (49) emphasizes the difference between the immediate blood raising action of pituitary extracts and this true *diabetogenic* action exhibited only after repeated injections of the gland. He found that in the normal dog, when the daily amounts of extract were suit-

ably increased, the symptoms reappeared only to disappear again after a short period. Young increased the amount of extract injected at intervals of three days and found that the animal remained continuously diabetic during the period of injections. By increasing the daily dose to a very high level (crude extract equivalent to 25 gms. of fresh tissue), it was found that the dog, instead of becoming resistant to the extract, lost its resistance. Of the greatest interest, however, was the fact that when daily injections ceased, the diabetic condition continued and had apparently become permanent. Young reports six dogs so treated, only one of which failed to become permanently diabetic (52). Campbell and Best (7) and also Dohan and Lukens (14) report similar results.

The production of a permanent diabetic condition in animals, without recourse to surgical interference, is another important step in the search for the etiological factors in human diabetes. Long points out that Young's experiments not only demonstrate beautifully the fact that an excess of one hormone may produce an insufficiency of another but that such excess operating over the limited time of two or three weeks may lead to a permanent impairment in the form of an experimental diabetes.

Clinical influences which lead to temporary hyperpituitarism must be scrutinized with their significance for diabetes in mind. The two outstanding examples of such coincidences are the menopause in women and the appearance of abnormal growth in children prior to the onset of diabetes, emphasized by White and Pincus<sup>1</sup> (29). Evans (17) has briefly reported the persistence of diabetes in two dogs after approximately nine months of treat-

<sup>1</sup> See chapter III (29).

ment with a growth hormone preparation. Long (32) argues that, although relatively few diabetic patients show frank signs of hyperpituitarism at the time of examination, such a phase may have long passed, leaving none of the characteristics of a continued excess of these hormones but only evidence of its temporary occurrence in the permanently altered metabolism.

That there is an anterior pituitary fraction which has an "anti-insulin" action as distinct from the diabetogenic action of crude gland extract has been well established. Houssay takes exception to Lucke's calling this *contra-insular* hormone. Young also agrees that it would be inappropriate to use such a term until it has been determined that the substance is antagonistic to all known actions of insulin. Young suggests calling this *glycotropic* pituitary substance for the present. The glycotropic substance has the property of neutralizing the action of insulin and one unit is considered the amount which is capable of neutralizing, or almost neutralizing, the action of two units of crystallized insulin in a rabbit after a twenty-one-hour fast [Young, (51)]. This anti-insulin activity has been attributed to prolactin. Young showed by an elaborate series of experiments that the substance, though present in the usual preparations of prolactin, is not identical with it. It is also distinct from the thyrotropic, gonadotropic and oxytocic (from the posterior lobe) substances. He leaves open the question of whether it is identical with the adrenotropic or ketogenic substance. Collip (9) reports an anti-insular substance from the pars intermedia. Young (50) does not know whether this corresponds to his glycotropic substance or not.

Although the glycotropic substance antagonizes the hypoglycemic action of insulin, it does not itself produce hyper-

glycemia. Cope and Marks (10), however, found that the hyperglycemic action of subcutaneously administered adrenalin was abnormally great in rabbits so treated. They explained the abolition of the usual hypoglycemic action of insulin in these animals on the basis of more rapid formation of glucose mobilized from the liver by the adrenalin. It is of special interest that animals treated with glycotropic substance which, as emphasized, has no sugar raising action in itself, are especially susceptible to emotional hyperglycemia, and great care has to be observed in handling them [Young (50)]. Perhaps this is through the increase of adrenalin along the lines experimentally obtained by Cope and Marks.

Anselmino, Herold and Hoffmann have described both fat and carbohydrate metabolism hormones elaborated by the anterior pituitary lobe. Special interest attaches to their claim that one of these has a *pancreatotropic* action and that administration of an anterior pituitary extract to rats results, after a few days, in a substantial increase in the number and size of the islands of Langerhans. Their conclusions were based wholly on the histological appearance of isolated or serial sections of the pancreas. This method, as Young points out, is open to serious objections which would explain much of the disagreement on their findings.

Richardson and Young (43), using what the latter described as a "tedious but objective method" for the quantitative determination of the pancreatic islet tissue in the rat, found that animals which had received daily injections of crude saline extract of fresh ox anterior lobe showed about twice the amount found in control animals. They did not get any appreciable change by the use of the preparation employed by Anselmino et al.

Young points out the significant fact that the type of extract which produced diabetes in the dog was that which was found to be effective in increasing the amount of islet tissue in rats. The suggestion is made by Young that the islet hypertrophy was a compensatory response to a diabetic condition induced by injections of the extract which was more prompt and effective in the rat than in the dog. The blood sugar levels of the rats remained within normal limits, and Young questions whether the reaction can be explained merely as a compensatory response to the diabetogenic action of the extract.

The pancreases of two dogs undergoing treatment with diabetogenic pituitary extract were examined for any signs of hypertrophy of islet tissue. Richardson and Young found indications of unusual mitotic activity which is considered most rare in this tissue in the dog, suggesting an unusual rate of proliferation. Hydropic changes were found to be present in other cells. Best and Campbell, confirming Young's findings on the production of a permanent diabetes in dogs by anterior lobe treatment, also observed changes in the histological picture of the islands of Langerhans in one of these dogs (52). Young points out that as yet there is no evidence that islet tissue formed under the influence of anterior lobe extract has the power to secrete insulin. If it does have, this may explain the dogs' ability to become resistant to small daily doses of extract. Whether there is a specific substance of the anterior pituitary causing islet hypertrophy which could be called *pancreatotropic* or whether this is a property of some already recognized hormone, Young is not prepared to say, but he is inclined toward the former belief.

*Adrenal:* The role of the adrenal is of interest from two points of view. The

immediate hyperglycemic and glycosuric action of injections of adrenalin, as well as this reaction to emotional disturbance, has been established. This has been used as an argument for a diabetogenic property of the adrenal medulla. Although this action must be of importance in so-called emotional hyperglycemia and glycosuria, and perhaps in temporary fluctuations in the diabetic, its diabetogenic action has been challenged; and there seems to be little evidence at present to support the contention that human diabetes can be brought about through the action of adrenalin. Houssay (24, 25) reports that daily injections of adrenalin for weeks does not bring about diabetes in animals, and that secretion of the adrenal medulla is not necessary for the maintenance of blood sugar which remains normal in dogs with denervated adrenals or with the adrenal medullae removed. Houssay goes so far as to maintain that neither cortin nor any known adrenal substance has any diabetogenic properties, basing this statement on findings in normal or hypophyso-pancreatectomized dogs or toads.

Long (33) disagrees with this latter statement. Though he is in agreement with the conclusion that the adrenal medulla does not play any decisive role, the cortex he considers important if not essential. Long and Lukens were impressed with occurrence of defects in carbohydrate metabolism in adrenalectomized animals together with the atrophy of the adrenals with excision of the anterior pituitary. They eliminated the possible action of the medulla and showed that the diabetes of depancreatized cats and dogs could be markedly ameliorated by adrenalectomy with giving of sufficient cortin to keep the animal alive. The results were comparable to those obtained in hypophysectomized-depancreatized animals. When these experiments were first performed,

Long and Lukens were unable to produce exacerbations by giving additional cortical extract, but later experiments showed that failure was due to insufficient dosage.

The injection of crude extracts of the anterior pituitary does not produce glycosuria in fasting normal rats, and, according to Long, it is only with difficulty that this effect can be shown in fed animals. Changes in the islet tissue in such animals found by Young has already been mentioned. Long found, however, that glycosuria is readily produced by such extracts in well-fed, partially depancreatized rats, or if present, it is greatly exaggerated. Such action is abolished, however, after removal of the adrenals. This action could not be explained either by the effect of loss of the adrenal medulla or by the poor condition of the animals after adrenalectomy. From these experiments on normal and partially depancreatized rats and on review of present known data, Long argues that the similarity of the effect on diabetes of hypophysectomy and adrenalectomy lies in the fact that one or all of the hypophyseal hormones exert their influence upon metabolism through stimulation of the adrenal cortex. The situation is comparable, he maintains, to abolishment of the action of the thyrotropic hormone by thyroidectomy. He concludes that with adrenalectomy an animal is incapable of reacting to the diabetogenic action of its own or foreign anterior pituitary extract. He feels that at the present time it is not possible to reconcile the difference in his and Houssay's findings except by invoking the excuse of species difference (33).

*Thymus:* Long (33) showed that the removal of this organ does not prolong the lives nor alter the character of the diabetes of totally depancreatized cats.

*Thyroid:* Administration of thyroid does not induce diabetes in normal

animals nor increase the glycosuria of depancreatized-hypophysectomized dogs [Houssay (24)] which has been confirmed in cats [Long (33)]. Most authors report that removal of the thyroid in animals increases insulin sensitiveness. This sensitiveness is increased if the pituitary is also removed. Thyroid treatment, if not too great, increases the resistance to insulin in normal or thyroidectomized animals. In humans, total thyroidectomy ameliorates the symptoms of diabetes but is impractical because of disagreeable symptoms of hypothyroidism. Hyperthyroidism is an unfavorable complication of diabetes in which improvement can be brought about by subtotal thyroidectomy. According to Houssay (24), quoting from John, Joslin and others, hyperthyroidism occurs in an average of 1.68 per cent of cases of primary diabetes, and diabetes in 2.3 per cent of cases with primary diagnosis of hyperthyroidism. Foster and Lowrie (18) in a series studied at the Ford Hospital, found the incidence of thyrodiabetes in diabetic admissions to be 2.41 per cent, and in hyperthyroid admissions to be 2.43 per cent. They feel sure that the diagnosis of hyperthyroidism as a complication of diabetes is being overlooked. These authors emphasize the different mechanisms between the glycosuria and hyperglycemia caused in hyperthyroidism by accelerated glycogenolysis and in diabetes by failure of oxidation of glucose. Menninger (38) calls attention to cases in the literature reported by Emerson and by Newburg and Camp in which a close relationship between a psychogenic thyroid disturbance and a diabetic picture was found. Newburg and Camp report the clearing up of the diabetic picture with psychotherapy which led them to revise the original diagnosis of diabetes.

Shepardson and Shapiro (46) have recently reviewed the literature on the



Achard-Thiers syndrome in which tumor of the suprarenal cortex is associated with diabetes, adding a case of their own. They discuss the fact that diabetes occurs only occasionally in association with the suprarenogenital syndrome and are forced to the conclusion that those patients who develop the Achard-Thiers syndrome must have the anlage of diabetes present.

*Liver:* Authors agree that the liver is necessary for maintaining the normal blood sugar as well as for the production of hyperglycemias (diabetic, adrenalinic, asphictic or anesthetic), and is absolutely necessary for the production and maintenance of the diabetic action of the pituitary [Houssay (24)]. We will not attempt in this review to go into the complicated problem of muscle glycogen in the problem of diabetes.

*Gonads:* The participation of the gonads in diabetes mellitus awaits much clarification and in order to present some of the problems which await an answer it is necessary to depart from the purely experimental field and indicate certain phenomena that are recognized but upon which animal experimentation has thrown little light.

One of the very interesting laboratory findings which have been applied clinically was the discovery by Barnes, Regan and Nelson (3) that in depancreatized dogs and monkeys injections of amniotin brought about a marked improvement in hyperglycemia and glycosuria with longer survivals. This they explained on the basis of the inhibitory effect of estrin on the anterior pituitary. Soskin, Mirsky, Zimmerman and Crohn (47) applied these findings to the treatment of clinical diabetes. They report that the results were essentially the same as those obtained in animals. The well-being of the patient could be maintained when insulin was entirely withdrawn, and there was some temporary alleviation of the hyper-

glycemia and glycosuria. As in the animals, no ketone bodies appeared in the urine throughout the observations, regardless of the degree of carbohydrate manifestation. Mazer, Meranze and Israel (36) report positive results in diabetic patients. Collens, Slo-Bodkin, Rosenbliett and Boas (8) report negative results.

Relatively little space is given in the reviews to the role of the gonads in diabetes. Houssay reports that pancreatic diabetes was found to be similar in castrated dogs and cats to that induced in the normal by pancreatectomy. An increase of the sensitiveness to insulin has been reported immediately following castration although later a slight increase in insulin resistance can be found. There is rather general agreement that the early state of pregnancy intensifies or does not change the condition and that lactation ameliorates it (24). Houssay (26) reports that the follicular stimulating hormone has shown a diabetogenic action in the toad which he considers is probably due to an impurity. There is no such action in the dog. A preparation of luteinizing hormone had no diabetogenic effect in the dog and only a minimal influence in the toad.

The greater incidence of diabetes in women during the menopause, referred to by numerous authors, brings up the importance that the gonads may have in this. In the menopause we are dealing with a disorganization of sexual function, the predominating feature of which is cessation of ovarian activity which Albright has aptly called "ovarian amenorrhea". The autonomic nervous phenomena associated with this period are caused chiefly by accumulation of follicular stimulating hormone of the pituitary. Most prominent and typical of these symptoms are the hot flashes. Albright (1) used the hot flashes as a quantitative measure to determine



whether the symptoms were due to hypo-estrinism, excess of gonad stimulating factor of the anterior pituitary, or to some third factor. He proceeded on the well-known fact that estrin ameliorates the menopausal symptoms. He found that the flashes did not appear until some time after the estrin had completely disappeared from the urine and the anterior pituitary factor had risen to a high level. Symptoms then did not subside immediately after administration of estrin, no matter what the dosage, but required a delayed period until the anterior pituitary factor had sufficiently decreased. Presumably the effect of the estrin was to inhibit the production of excess of pituitary secretion or some intermediate substance responsible for the hot flashes. The question must arise to what degree the higher incidence of diabetes during the menopause lies with ovarian hypofunction and the over-activity of the anterior pituitary in consequence. A study of the incidence of diabetes following castration might shed some light on this problem.

There are well recognized disturbances of the sexual function which, with the present attention to neurotic complications in diabetes, require further study. These consist of the complaint of lessened libido sexualis (sometimes increased after administration of insulin), fluctuation with changes of the diabetic picture, the common complaint of pruritus vulvae in the female and not infrequently the appearance of frigidity and impotence and frequent neurotic symptoms related to disturbance of sexual function. The question arises whether these are secondary manifestations or are of a more primary order. There is little in the literature on this point. Daniels (11) reports sexual changes accompanying diabetes, as does Menninger (38) who adds, in regard to impotence and frigidity, that

these are not caused by the disease except in extremely severe cases. This last statement must be questioned.

A striking illustration of the close relationship between depression of libido sexualis and alteration in clinical diabetes is given by Daniels (11):

A young woman consulted Dr. Herman L. Davis, of San Antonio, Texas, in December, 1932, complaining of polyuria, polydipsia, and pruritus vulvae. Her urine was four plus and her blood sugar 370. Five months before her urine had been known to be negative. After a short period of dietary treatment the urine became negative and the blood sugar normal. She continued the diet and remained sugar free for a year and a half under close supervision. A month before one of her visits to the office she experienced a return of the excessive urination, thirst, and pruritus vulvae. Laboratory findings were strongly positive for both blood and urine. A check on the usual medical factors gave no explanation for the change. Dr. Davis suspected some emotional factor might be the variable. On making inquiry, the patient told him that she was sexually intimate with a young man whom she hoped to marry. In the midst of conflict over doubt and uncertainty as to the outcome, another diabetic patient happened to mention one day that diabetic patients often lose their sexual desire. His patient immediately began to fear that this would happen to her, and her fears were promptly realized. After discussion of the difficulty with Dr. Davis, her sexual potency returned and with this the sugar fell to its previous level.

The following causes of sexual disturbance in diabetes are suggested: 1) secondary effect on the gonads from other endocrine malfunction; 2) secondary effect from other physical factors such as toxic; 3) primary disorder of the gonads with secondary changes in other endocrine glands including the pituitary; 4) regressive personality changes leading to disturbance of sexual function; 5) incidental presence of

neurotic symptoms unrelated to the diabetes; 6) the presence of a neurosis, one of whose manifestations is diabetes mellitus; 7) a combination of these.

*Pancreas:* One of the most sweeping revisions which the recent concepts of diabetes have brought about has been the rejection of the simple insulino-genic theory of diabetes. Minkowski's discovery of the effect of total pan-creatotomy in dogs with its far-reaching influence, followed later by the brilliant results of the therapeutic effects of insulin, served to discourage the search for other factors until Hous-say's epic discovery.

Although there is no question of the importance of the pancreas in the condition, it is at present doubted in many quarters whether insulin deficiency is the real cause of the disease, for it has not been definitely proved that a real deficiency exists. Long points out that not over 25 per cent of diabetic pan-creases show lesions at autopsy and neither do assays of the pancreas for insulin necessarily show a deficiency (32). Hous-say points out that, inasmuch as there is as yet no method of measuring the insulin content of the blood, it is im-possible to maintain that there is an actual deficiency (24). Further, Long points out that as insulin will abolish glycosuria due to a wide variety of agents, its effect in diabetes is not a specific one and that caution should, therefore, be used in interpreting its action as proof of insulin deficiency. What is certain is that there is insuffi-cient insulin to overcome the metabolic disorder. This may as well be due to in-sulin resistance or overproduction of glucose as to primary deficiency.

Long, in summarizing the endocrine mechanism responsible for metabolism, points out that not only individual glands are of importance but also the interaction of one on the other. He enumerates the complicated interaction

when there is a deficiency in one. The metabolites which accumulate may further stimulate, and thus further weaken, the impaired gland. A hypo-function of one gland leads to a hy-perfunction of those glands which ordinarily affect metabolism in the opposite direction to the defective member. Thus, the effects of such hy-peractivity are superimposed on the hypoactivity of the affected gland. Examples given are the relative hyper-activity of the anterior pituitary follow-ing pancreatectomy, thyroidectomy or castration. Such hyperactivity leads to a further series of complications. Hous-say points out that the secretions of the anterior pituitary work in antagonistic and reciprocal balance with the pan-creas. Reduction of pancreatic function favors anterior pituitary activity and *vice versa*. He suggests that an imper-fect conception of the diabetic state can be arrived at by considering the pancreas as an antidiabetic factor and the anterior pituitary, adrenals and thyroid as diabetes stimulating or dia-betogenic factors.

*Nervous System:* It is uncertain to what degree the nervous system enters into carbohydrate metabolism regula-tion and disturbance. That the auto-nomic nervous system works in con-junction with the endocrines, leading to smoother performance and quicker action in emergencies, is generally agreed. The contention that the secre-tion of the pancreas is mediated pri-marily through the central nervous system, as maintained by La Barre (24) and Lucke (27), has not gained much support. Hous-say, through work done at his institute, considers that the vagus innervation of the pancreas, though capable of some regulation, plays a minor role.

Ingram (27) points out that the in-fluence of the nervous system in me-tabolism should not be overlooked as

there is the possibility that certain glands not excluding the liver may be under a certain amount of nervous control. Most of the endocrine glands, according to Grinker (19), can function without such control if the pituitary is intact. The exceptions seem to be the parasympathetic posterior lobe and the adrenal cortex.

*Hypothalamus:* The actual information on the implication of the hypothalamus in diabetes is at present indefinite and contradictory. Grinker (19) summarizes the relationship of the hypothalamus to carbohydrate metabolism as follows: The paraventricular nucleus has been implicated by some authors as the cause of diabetes mellitus and Morgan claims that it is found atrophied in the disease in man. Injury to the lateral portion of the tuber cinereum prevents diabetes in depancreatized dogs. Damage to the paraventricular nucleus increases sensitivity to insulin. The ventromedian tuber nucleus is thought by some to be concerned in the control of the liver, pancreas and adrenal cortex. Stimulation of the posterior hypothalamus assists in mobilization of the carbohydrate reserves through excitation of the adrenals. The only conclusion that can be definitely drawn is that the posterior hypothalamus may be concerned in the function of these glands, not only in emergencies, but in their constant level of activity. Whether disturbances are due to the loss of a direct and specific control, or an indirect influence of the hypothalamus on the hypophysis, pancreas, adrenal cortex or gonads, is not yet known.

Davis, Cleveland and Ingram (13) confirmed the findings of Weed, Cushing and Jacobson that glycosuria appears after puncture of the hypothalamus and that stimulation of the cervical sympathetic ganglion is followed by glycosuria. Barris and Ingram observed

transient hyperglycosuria following a lesion almost anywhere in the hypothalamus, which they explained as due to irritation of the hypothalamico-adrenal mechanism.

A further modification of the Housay experiment was performed by Davis, Cleveland and Ingram on animals (13). With bilateral hypothalamic lesions, a comparable effect on pancreatic diabetes, whether the pancreatectomy was performed before or afterwards, was obtained. The lesions must be situated in the tuber cinereum slightly rostradorsolateral to the mammillary bodies at the level of the ventromedial hypothalamic nucleus. The glycosuric effect of stimulation of the cervical sympathetic was also abolished by these lesions. Barris and Ingram found that such lesions may also interfere with the action of hypophyseal extracts.

The hypothalamus is the portion of the nervous system which may give the key not only to some disturbances of carbohydrate metabolism, but especially to those caused by emotional disturbances. Much information is accumulating in regard to it as a center for visceral discharge of tension. Bard's production of sham rage reactions by removal of the influences of the higher cortical centers, and Ranson's evoking of these same reactions by stimulation of the lateral portion of the posterior hypothalamus, are classic examples. Grinker points out that as the center for autonomic control, it is all important not only for the equalization of impulses stimulated by the external environment but also for the equalizing and discharge of impulses arising from within the organism. When these are interfered with, anxiety may result. Grinker, closing his very exhaustive and informative review, gives the following illuminating exposition of anxiety which he elsewhere states finds its

discharge through the medium of the hypothalamus (19):

In anxiety . . . the danger is not real, it is unknown, internal, and results from an increase in instinctual tension demanding expression. As Freud points out, it is a conditioned signal within the ego, conscious within the personality as a warning of impending danger. There are specific unpleasurable feelings, efferent discharges and their perception. The result may not be fight or flight, as to a real danger, but a paralysis of certain higher ego functions. Anxiety is then the first sign of an autonomic influence on the cortex or ego, which has been learned by previous testing to indicate danger for the organism. It is a feeling which accompanies autonomic forces sufficiently strong to overcome cortical inhibition and force the cortex into activity, movement resulting in an attempt at solving the situation which has evoked the internal tension. Psychological fight or flight or compromises are attempted. Often successful solutions are not possible and the cortex or ego "gives up", allowing regressive and infantile modes of exteriorization of emotional expression, for the sake of avoiding more prolonged or greater emotional feelings. The result is visceral expression or organ dysfunction, which we term organ neuroses, that constitute the first step toward organic disease.

The hypothalamus has a master position over the autonomic system as the pituitary does over the endocrine system. Furthermore, there is probably a close interrelation between the two. Grinker points out in this connection, the close association of the two, their common embryonic derivation, and the demonstrated innervation of the hypophysis. If there is a direct relationship and if diabetes may be caused by temporary or chronic hyperfunction of the anterior pituitary as suggested by Young, then this would appear to be the route through which emotional disturbances could make their impact.

Considerable space in this review has

been given to contributions from the experimental field because this holds out at the present time the best chance not only of ultimately solving the biochemical basis of carbohydrate metabolism, which is vital for internal medicine, but also of clarifying the psychosomatic aspects of diabetes mellitus. As various investigators point out, what is true for certain species of animals is not necessarily true for the human being, and this caution has to be further extended when we are attempting to explain mechanisms involving a psyche. However, the review of recent literature on such psychic factors shows how important it is for the different fields to exchange their knowledge in a hitherto neglected attempt to come to some common formulation of phenomena of great clinical importance. The experimental field appeared to furnish the nearest approach to such common ground.

#### FROM THE FIELD OF GENERAL MEDICINE

Mention has been made of the receding interest in general medical circles in emotional factors in diabetes. The neglect, or lack of appreciation of psychic factors, is impressed on one in going over the literature of the past five years. From January 1934 through March 1939, of 3333 articles on diabetes listed in the Quarterly Cumulative Index Medicus, there were only 23 with titles which called attention to this aspect of the problem; and on combing the rest of the literature, little or no reference to psychic factors is found. Although this number of titles is somewhat greater than the actual number of articles, because of duplication in cross indexing, the disproportion is evident. In most instances the problem of whether diabetes can follow shock is the major concern. Except in the articles definitely written from the psy-



chological or psychiatric viewpoint, even the subject of fluctuations in the disease due to emotional changes—of which almost every physician is aware—is not re-emphasized nor included with any regularity among the complications of the disease. One gathers that this is partly because it is not fully appreciated, and partly because it is thought of as being “unscientific”. A well-known specialist in the field was asked why it is that so little mention is made in the present literature of such factors. His reply was that this is already known and taken for granted. It would seem just as sensible to omit other well-known contributing or complicating factors for the same reason.

The chief case against the importance of emotional factors in diabetes reflected in the literature can be enumerated under the following heads: 1) recent studies showing heredity to be the determining factor; 2) the experience of the World War; 3) nervous strain or shock does not lead to more diabetes or to any appreciable increase in hyperglycemia or glycosuria in those already having diabetes; 4) confusion between organic neurological changes and emotional tension utilizing autonomic neurological mechanisms for discharge.

*Heredity:* The question of the heredity factor in diabetes has long been raised in medical literature, and recent studies would indicate that it should be taken seriously. These studies have been carried out by Pincus and White, (39, 40, 41). Much of their data has been worked out on the basis of Joslin's cases supplemented by other statistics (29).<sup>2</sup> Joslin himself is thoroughly convinced of the importance of these findings and makes the statement that “heredity is the basis of diabetes” (29). White and Pincus state that the relin-

quishment of the conviction that obesity was necessary for the development of diabetes was modified by the study of children who were not overweight, and one gathers that the focal point has been shifted in this school from obesity to heredity. They state that at the present time it is possible to predict where diabetes will develop but not why. The conclusions drawn from their evidence are all that can be stated here:

1) The almost simultaneous occurrence of diabetes in both members of pairs of similar twins. The incidence in similar as compared with dissimilar in the nineteen cases studied showed a ratio of 69 per cent as against 10 per cent.

2) The greater incidence of diabetes in 4434 blood relatives of diabetic patients, parents and siblings which was found to be 6.7 per cent, as compared with 1290 parents and siblings of non-diabetics which gave 1.23 per cent. The authors quote similar experience of others.

3) Demonstration of Mendelian ratios of the recessive type. The authors were unable to demonstrate simple dominance and do not believe it exists because of a) the tendency of diabetes to skip one or more generations, b) the low incidence of diabetes in parents of patients. If the trait were transmitted by simple dominance, eventually one parent in each family would be diabetic; actually, only 9 per cent are. They emphasize the tendency of the lay, and even the genetically untrained medical mind to think in terms of simple dominance, and therefore to reject the evidence for recessive types of transmission.

4) Demonstration of recessive Mendelian ratios in presumably latent diabetics. The authors found not only significant excess of elevated blood sugars in relatives of diabetics, but also

<sup>2</sup> Cf. p. 528 fn. 1.

the proportion of hyperglycemic individuals in the three types of mating was found to approximate closely simple Mendelian recessive probabilities 1:2:4 in carrier $\times$ carrier, carrier $\times$ diabetic, and diabetic $\times$ diabetic. This was found to be true for Joslin's tables and those of the Massachusetts Health Service. On this evidence the authors base their conclusion that examination of blood sugars has enabled them to foretell by many years the future diabetics.

White and Pincus also point to evidence that diabetes is caused by two factors: 1) undersecretion of insulin and 2) the diabetogenic hormone of the anterior pituitary. They present as further evidence of the implication of the pituitary a) the appearance of diabetes at eleven years of age, b) increased activity of the anterior pituitary during the menopause, c) the involvement of the anterior pituitary in cases of obesity, d) the alteration in diabetes by removal of the pituitary in animals, and e) the ability of anterior pituitary extract to produce diabetes in animals. They state that endocrine functions are known to be controlled by recessive Mendelian genes, quoting Castle's work on dwarfism. They believe it highly probable that the development of diabetes depends primarily upon the transmission of a single recessive gene and the operation of one or more secondary factors.

Dunbar et al (15) report that of the sixty diabetic cases studied in their series, neurotic and psychotic heredity or exposure was of much more frequent occurrence than was diabetic heredity, and that cardiac heredity was strikingly absent.

The importance of hereditary predisposition and the experience of the World War (1914-1918) are used as the most telling arguments against the importance of emotional factors in the

etiology and course of diabetes. These arguments are put forward as though the whole question could be disposed of now. Almost the only literature in English from general medical sources, during the period covered by this review, runs in this vein. It is recognized that this does not necessarily represent general medical opinion, but as this is the only source of guidance outside psychiatric literature, it seems important to indicate the arguments given.

Joslin (28) who had formerly stressed the importance of nervous stress and strain on the course of diabetes, has reversed his position and states that whatever influence previously had been attributed to this can now be explained by heredity and obesity. He cites von Noorden's experience in the World War which led him to the conclusion that "... neurogenen Diabetes gibt es überhaupt nicht; die Kriegeserfahrungen haben ihn vollends zu Grabe getragen". Joslin's own war experience was along similar lines. As consultant for the hospital center in Merves, France, through which 40,000 soldiers passed on the way back from the front, only two cases of diabetes were discovered, and his interest in the subject was well known.

P. D. Matz, Chief Research Subdivision, Veterans' Administration, also quoted by Joslin, reporting on 300 patients among ex-service men, came to the conclusion that evidence for the importance of the neurogenic factor and traumatic factor as a possible cause of diabetes in modern warfare is not convincing. The inception of the disease he feels can better be explained by constitutional predisposition, obesity, faulty metabolism and internal secretory disturbance. A later paper (35) in which he reports on 1663 living diabetic veterans does not convince one of the author's ability to penetrate such a problem as the rela-

tion of neurosis to diabetes. Of these cases, 129 were diagnosed as psychoneuroses. In sixty-five instances the psychoneurosis followed the inception of diabetes, from which he assumes that the diabetic disease was a direct or contributing cause of the psychoneurosis, but he is not so consistent with the twenty cases in which the psychoneurosis preceded the inception of the diabetes—in regard to which he says that the two may not be in any way related except that the diabetes may have prolonged the psychoneurosis. In forty-four of the cases it was not possible to ascertain whether any relationship between the two diseases existed. Such a series would not furnish telling argument one way or the other without careful evaluation of the individual cases, which, if done, was not reported.

That shell-shock does not have diabetes as a frequent complication, is important to know. Even though this were established, however, it would not serve as incontrovertible proof that severe psychic trauma is not important in diabetes. It would mean that this particular type of trauma was not a largely contributing cause or that there were other conditions of military life that mitigated against the appearance of the diabetes. Dr. Dana Atchley has called my attention to the factor of low carbohydrate diet in the army as an important consideration in this regard. Some of the classic cases of traumatic diabetes in the literature, however, are war cases, and these and some of the extremely interesting cases recorded from civil life should not be relinquished without further evaluation.

Joslin argues, further, that experience with emotional states upon the course of existing diabetes is also against their importance in the etiology of the disease. He contrasts obesity

and excitement. Although the prevention of obesity is important in the treatment of diabetes and its causation, no such dual rôle can be ascribed to nervous excitement. He agrees with the experience and conclusions of von Noorden who reports with Isaac findings during a total of 250,000 days of care of patients with diabetes. Severe emergencies arose almost weekly with one or more patients, registered frequently by sudden marked exacerbations of metabolism. The resulting glycosuria, however, lasted rarely for several days, more often subsiding in a day or a few hours. On the whole, the positive effects of such periods of excitement were far less than the negative results. Patients would often remark that the analysis must be very bad on a certain day because of this or that upsetting circumstance, but their predictions would not be fulfilled. Often the analyses would correspond to those of the previous day, or it was not uncommon to find that the urine tested under the influence of excitement was more favorable than before, both in light and severe cases. In general, the milder the diabetes, the more clearly positive the results of the emotion. According to the view set forth, in severe diabetics the inherent diabetic factor was sufficiently powerful to overcome the nervous blow. The information reported is interesting and important and needs further interpretation rather than dismissal because it is seemingly contradictory.

Root (44), after citing an interesting case of a man who developed diabetes after a very narrow escape from a bad automobile accident, argues against the importance of emotional factors. He is confused between the question of organic brain lesion and the effect of emotional disturbances, pointing out as proof against the importance of psychic trauma, the fact that patients with or-

ganic brain injuries leading to glycosuria do not develop diabetes. He cites the findings of Davis, Cleveland and Ingram, but over against the influence that the hypothalamus may have on the pituitary, he places the importance of the islands of Langerhans because they exert the controlling influence on the blood sugar level. It is a long leap, he argues, from temporary glycosuria produced by trauma of the brain to clinical diabetes with its manifold variations and many complications.

M. Schur (45) makes a plea for the integration of the accumulated experience in diabetes with the increasing knowledge of the hereditary factor. More is known about constitutional factors in diabetes, he argues, than about the influence of emotion, and although centrally determined diabetes has not been proved, it does not seem wholly improbable. He points out that sufferers from diabetes show pathological carbohydrate metabolism long before their manifestation of overt symptoms. A diabetic anlage and a certain metabolic error do not in themselves represent diabetes in the clinical sense.

At any time a latent diabetes can be aggravated into an actual one as, for example, in the case of infection. It is in the manifestations of diabetes without such demonstrated external factors that little or nothing is known—for we have no knowledge of the transformation of a latent into a manifest form. There is a great deal of difference whether a person develops diabetes from trauma at twenty-five when this disease is apt to be particularly severe, or in the absence of trauma at forty years.

There is a great difference, Schur argues, in the span of life, capacity for social concurrence, and satisfaction in general, between latent and manifest diabetes. No one can show that cases of

traumatic diabetes would have become manifest diabetes without trauma. Our lack of information does not exclude the possibility of a latent diabetes becoming manifest in this way. Not only may influences be exerted through the central nervous system and pancreas, but also the discovery of an increasing number of endocrine factors opens up new possibilities.

It is well known that psychic trauma can alter tolerance for a long space of time. If in such cases therapy has no regulating effect, a vicious circle is set up, as we know that every decrease in tolerance aggravates the metabolic disorder. We do not know, therefore, what irreversible results may come from psychic trauma. Schur cites a case of Umber's in which a prisoner of war developed an acute diabetes after his brother, who was a fellow prisoner, was shot in his sleep, and feels that the burden of proof that this would have come without the trauma lies with the other side.

#### FROM THE PSYCHIATRIC FIELD

That neurotic manifestations occur frequently in association with diabetes, is becoming increasingly clear as cases are studied systematically by observers trained in psychiatric methods. W. C. Menninger in two articles (37) (38) reviews previous literature, reports on 30 cases of mental disorder associated with diabetes, and analyzes this material along with that of 93 cases of uncomplicated diabetes and 400 uncomplicated cases of mental disorder. Daniels (11) and Dunbar et al (15) report studies on successive diabetic admissions to a large general hospital which allowed them to contact cases that ordinarily would not be seen by the psychiatrist. Dunbar et al contrast the diabetics studied with parallel series of fracture and cardiovascular patients.



In his review of the literature Menninger found psychoses to be relatively rare. According to Masson, only 1.2 to 1.7 per cent of diabetics develop psychoses. On the other hand, although psychoneuroses are frequently associated with diabetes, he found almost no mention made of the fact in the literature up to 1935. Menninger listed nine of a series of thirty cases studied by him as psychoneurotic. He was impressed with the inconsistency of the opinion that there is little dissension regarding the great importance of the psychogenic factor once diabetes is established, and yet so conservative an opinion as to these same influences initiating a metabolic disorder. He also feels there is no justification in setting forth the description of a disease entity and tests for its diagnosis, and then calling an identical entity "emotional glycosuria" because it has psychological origin, regardless of our inability to examine the pancreas.

Menninger calls attention to the present viewpoint of psychiatry that some of the most severe emotional conflicts are entirely unconscious to the patient, but with the exception of three authors he found no recognition of unconscious emotional conflicts.

Menninger classifies five of his thirty cases as *diabetes as a result of a psychological disturbance*, appearing either with a mental disorder or during its course. These cases conformed to the following arbitrary requirements of such relationship: 1) obvious psychopathology was evidenced prior to the development of the diabetic state; 2) the mental picture was quite different from the toxic state occasionally seen in either hyperglycemia or hypoglycemia; 3) the course of improvement of the mental picture was paralleled by the glycemic and glycosuric levels, with fluctuations in these as emotional upsets occurred in the psychic life;

4) the metabolic disorder was indicated by a persistent glycosuria (without dietary control or insulin), retarded glucose utilization curves of the blood sugar, and a response to dietary, and in some cases, insulin therapy; 5) with mental recovery, the diabetic condition cleared, requiring neither insulin nor rigid dietary treatment. Menninger considers these the only such group described in the literature and gives abstracts of the cases in both of his articles. He states that none of the cases lent themselves to psychoanalytic investigation so that the unconscious forces could not be determined. Actual psychotherapy is mentioned in only one case.

One of the questions which repeatedly occurs is whether or not there is any characteristic mental picture in diabetes. This has various aspects. The first is the question of toxic psychoses attributable to diabetes. Menninger reviews the literature and comes to the conclusion that "such a group of toxic cases, to be regarded as diabetic psychoses, represents a small percentage of the number of cases in which diabetes and mental disease are associated". He cites three such cases in his own series.

Boudreau (6), who went through the literature, could find only nine cases, including three of Menninger's, in which he felt it was justifiable to consider a causal relationship between diabetes and the abnormal psychic states. To these he added three of his own. He concludes that "such toxic mental states seem to be independent of personality traits or inherent family tendencies, and to be caused by a state of hyperglycemia". That caution is necessary in concluding such toxic factors to be primary in determining the mental picture, is illustrated in one of these cases reported by Katz (30). Daniels, in discussing Boudreau's paper, pointed out that at the time he had seen this

patient at the Presbyterian Hospital she had presented the picture of an acute schizophrenic episode. A note in the chart, by the internist who had followed the case for three years prior to admission, laid stress on her marked feelings of inferiority and severe depressions over problems of masturbation. Additional data on the case showed the reaction to have immediately followed the patient's seeing the moving picture, "When Life Begins", which seemed to have mobilized her fears of pregnancy to which she had been recently exposed.

Further caution has to be exercised because toxic reactions may come from other complications such as arteriosclerotic or kidney changes. Lindberg's description (31) of such *diabetic psychoses* is not convincing because of the likelihood that such changes existed in the cases cited. Lindberg believes that although such psychoses are rare, there is a clearcut clinical picture which justifies the term. These psychoses he considers symptomatic along the lines described by Bonhoeffer as occasionally associated with special features of a paranoid or manic-depressive nature. The picture, he maintains, occurs almost exclusively at the age of 50 and above, and is not connected with the absolute degree of intensity of the diabetes as measured by sugar or acetone bodies, but is observed in varying sugar values with or without acetonuria.

Harris (20), after a careful review of experimental data showing the ability of the brain to utilize carbohydrate as its main source of energy, concluded that it is doubtful whether in mild or moderately severe diabetes there will be a disturbance of brain function with mental symptoms from the hyperglycemia alone. With severe diabetes, acetone, diacetic acid and beta-hydroxybutyric acid appear. Also there is a loss of base from the body with a dis-

turbance of the electrolyte equilibrium. Disturbances of inorganic elements and of circulation are responsible for the coma. He concludes that only in severe diabetics may mental symptoms come from the toxic effects of the disease, and then only in the last stages. He is not concerned with psychic trauma in this communication. He states, further, that it is of interest that mental aberrations in psychoses are similar to manifestations in hypoglycemia but seldom in hyperglycemia.

In a recent communication Baker, Fazekas and Himwich (2) re-emphasize that in the diabetic animal, cerebral tissue, unlike most other tissue, is able to oxidize carbohydrate with a respiratory quotient of approximately unity. It must, therefore, possess some mechanism for carbohydrate oxidation which does not include insulin. After a series of experiments in which nicotine was used, they conclude that in brain tissue it is possible for glucose to be oxidized completely to carbon dioxide and water through intermediates other than lactic acid. They add that their results do not preclude the possibility that in the absence of nicotine, part of the respiration may go through lactic acid, thus indicating at least two paths for oxidation of glucose in brain tissue. They point out that recently more evidence has been accumulating, revealing the ability of the body to oxidize limited but significant amounts of carbohydrate in the absence of insulin. The brain has developed this ability to a greater extent than other tissues of the body.

Menninger attempts to describe a composite mental status in diabetes which, though suggestive, is on the whole confusing. This may be accounted for by the fact that ten different psychiatric diagnoses were made on the material reported. Observations on the effect of diabetes on the intellectual functions are of interest but re-

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quire further evaluation. Diminished alertness and awareness of the environment are reported as characteristic, though the individual may be much more alert to his own condition and events affecting himself. Memory disorders, absent-mindedness and delayed psychic response are more pronounced in the diabetic than in non-diabetic individuals.

Menninger cites psychological studies done on diabetics by Miles and Root in which they found a decrement of 15 per cent or more in memory and attention tasks while testing 39 patients with hyperglycemia and glycosuria at the beginning of treatment as compared with controls. With treatment they found rapid improvement in psychologic status, approaching but not quite reaching normal. In five long-standing treated cases of diabetes, they noted that the accuracy and quickness of movements was 20 per cent below normal. Dashiell, also quoted, followed a case which when hyper- or hypoglycemia was produced showed increased deficiencies in the same rather than in opposite directions. It is not at all clear, from our present knowledge, to what such intellectual impairment is due. In toxic states in which memory disorders and delayed psychic response are common, awareness in general is impaired. The cases, in which there is a diminished awareness of the external environment with a heightened awareness of self, suggest the self preoccupation found in hypochondriasis. By narrowing the field of attention, intellectual efficiency is impaired. The fact that hypochondriacal reactions are common, especially at the beginning, raises the question whether the intellectual impairment described, except in the more severe cases, is real, or whether the patient is prevented from satisfactorily engaging in the task because of the personality disorder.

Depression is among the most frequent of the mental symptoms described, according to Menninger's summary of the literature. Daniels found depression to be an important complication in ten cases of the twenty-three diabetic admissions studied, either from the history or as present while under observation. In five cases the depression was reactive to the loss of a love object prior to the onset of diabetes. When possible it is useful, in the case of depression, to make the distinction between a depression of a primary nature which might or might not be related to the diabetes, and a depression secondary to the diabetes. The knowledge by the individual that he is suffering from an incurable disease which, on account of the care necessary in treatment, sets him apart from the rest of his fellows, in many cases explains the reaction. Much of the hypochondriacal self observation which often accompanies such depressions can be explained in the same way. Because it is so natural, however, to conclude that such a patient is upset over his condition, it is possible to miss more fundamental neurotic reactions which may play a more primary rôle. Cases of manic-depressive insanity, appearing coincidentally or alternating with the diabetic picture, have been described.

Beardwood (5) reported two cases of attempted suicide with insulin. One of these was by a physician who did not have diabetes who gave himself a large dose of insulin and lost consciousness during the reactions. He was given dextrose intravenously and recovered. The other case, reported in some detail, was a woman with diabetes who had taken 400 units of insulin just previous to her admission to the hospital. She recovered from this suicidal attempt.

Menninger calls attention to the frequency of paranoid trends in diabetic psychoses. In the thirty cases of dia-

betes complicated by mental disease which he studied, three were diagnosed paranoid state. In addition, all five of the schizophrenic cases were of a paranoid nature; three of the senile psychoses were primarily paranoid, and two of the three toxic cases presented paranoid delusions. In all, twelve of the series showed a paranoid set of delusions as the conspicuous mental content. He reports similar findings by other authors. The high incidence of paranoid delusions, he feels, is very unlikely a coincidence. He quotes Schim van der Loeff and Barnhoorn who conclude that paranoid symptoms should be included in the characteristic mental picture, believing their origin to be an exaggeration of trends in the direction prior to the existence of the psychoses.

Menninger found psychic trauma to have been important in the precipitation of two of his 93 cases of uncomplicated diabetes. Dunbar et al found such emotional traumata preceding diabetes occurred less frequently in their cases than in the cardiac and fracture patients, and that a long period of stress and strain was a more frequent occurrence. They point out, however, that such a period of stress and strain or definite emotional trauma immediately prior to illness is a frequent finding in numerous disease pictures and needs further evaluation.

The essential feature would not seem to be the trauma, although this may play an important part, but the type of conflict measured in terms of tension in the form of anxiety operating. Another important condition to have in mind is that it is not conscious emotional conflict which has greater opportunity to discharge through the voluntary nervous system that is most important, but repressed emotional tension. This explains much of the seeming contradiction in the effect of transitory emotional upsets on the

sugar level which so confused Joslin and von Noorden and led them to rule out the whole phenomenon as of little importance.

Daniels has pointed out that trauma which precipitates a neurosis has its effect because it impinges in many cases on an infantile neurosis which it reactivates, thus releasing more primitive anxiety patterns. Dunbar et al, in discussing diabetes, state that "from the psychosomatic point of view there is no more fundamental determinant of the organism's equilibrium together with its capacity to make adjustments than anxiety". In the diabetic and cardiovascular groups they find anxiety is a prominent factor. In these groups the somatic and psychic conditioning and expression of anxiety, they find present a contrast with the fracture group. From the patient's subjective viewpoint there is a significant contrast in that in the diabetic and cardiovascular groups the danger as well as the handicap is more diffuse and threatens from within, whereas in the fracture group the danger as well as the damage produced is concrete and seems to come from without.

Daniels (11), in his report on the twenty-three cases of diabetes studied in the general hospital, attempts an analysis of some of the emotional factors operating which may have been important in the generation of anxiety, and of its expression through disturbed metabolism. The incidence of depression has already been mentioned. In one case there appeared to be a very close relationship between the onset of the diabetes and the depression. In another, which turned out to have definite cycles of excitement and depression, touching on a source of acute conflict led on two occasions to a rise of the blood sugar a hundred points.

In two of the cases studied the diabetes appeared in childhood at the time



at which an infantile neurosis appeared to be acute. One patient, a girl of seventeen, said that her parents attributed her diabetes to a childhood fright from a dog. Although she had no memory of the event, she still had an active dog phobia. Her mother confirmed the story that a neighborhood puppy had jumped on the child and that she had run screaming into the house. Such a fright presumably would not have caused a lasting phobia if an infantile conflict situation had not been raging at the time. The precipitation of the neurosis might also conceivably have precipitated the diabetes. That the neurosis actually was responsible for the precipitation of the diabetes, certainly could not be proved. What is clear is that at this time she developed an anxiety condition which continued in the form of a neurosis up to the time of examination, and that history, as given by the parents, showed the sugar to date from this initial outbreak of anxiety. Presumably, psychic trauma, to disturb the organism sufficiently to cause disease, must be severe enough to temporarily shatter the ego as in shell-shock, or must reactivate strongly repressed latent anxieties. In this case the connection of the trauma with the neurosis, which was still present some twelve years later, is evident. Such latent anxieties may be operating in the absence of evident trauma, even without evident conflict. Without such an understanding of the problem, we will be tempted to settle the question of the possible psychogenesis of diabetes on a few dramatic cases without considering the constant interplay of psychic forces, unconscious as well as conscious.

Several of the cases in the series manifested anxiety of the type encountered in anxiety neurosis. A case of diabetes under analysis (12) showed such a picture along with an anxiety hysteria as encountered in the case of

dog phobia described above. Two other cases of diabetes, seen in the clinic, who were in the menopause, also had symptoms of anxiety neurosis. One had a low blood sugar during an attack, which was also a frequent occurrence with the analytic case, both before and after insulin treatment. Daniels points out certain similarities between the autonomic nervous symptoms of the menopause and anxiety neurosis, and raises the question of whether in some cases the diabetes may not be the extension of a physioneurosis resembling an anxiety neurosis in which, as during the menopause, there is a disturbance of the hypophyseal-gonadal relationship.

*Psychotherapy in Diabetes:* Psychotherapy in diabetes has been sporadic and in the main limited to cases with outstanding neuroses. In such cases the treatment appropriate for the neurosis is indicated. The methods in vogue, such as re-education, suggestion under hypnosis, mental catharsis, relaxation and psychoanalysis have been attempted. There are few case reports outlining such therapy. Bauch (4) appears to be the first one to attempt to develop a systematic psychotherapy for diabetes as a supplement to general medical care. The whole unsettled state of knowledge, in relation to both the nature of the metabolic disturbance in diabetes and in any associated neurosis, awaits further clarification before any systematic psychosomatic approach can be formulated. Suggestions regarding such approach have been made in the presentation of material, and further trends will be evident in what is to follow.

The ultimate understanding of psychopathology associated with diabetes must come from the exhaustive and painstaking study of cases, with parallel observations of accompanying physiological changes, such as changes of

blood sugar, and, if possible, hormonal determinations. The best method at our disposal at the present time for such minute psychological scrutiny is psychoanalysis. As has been indicated, it is not the conscious emotional disturbances which are the most important in somatic manifestations, but the unconscious ones which, having little or no opportunity for motor discharge on the conscious level, are driven to visceral discharge. Reference has already been made to Grinker's formulation of this problem in terms of hypothalamic functioning.

The fact that diabetics not infrequently have severe neuroses which require treatment, affords an opportunity to study the interaction of the two conditions, and makes it possible to combine a legitimate therapeutic aim with an as yet entirely experimental field—the influencing of the metabolic process itself through psychological means. That the diabetes in such cases may not respond, is not necessarily proof against a primary position of the neurosis. We know too little about reversibility in organic disease and the point at which this is no longer possible because of the advance of structural changes.

Daniels (12) reports the psychoanalysis of a case of diabetes. This is the first case so reported. The interrelationship between the diabetes and the neurosis appeared to be demonstrable. Of special interest is the fact that the case represented the type of diabetes with autonomic symptoms which may ultimately prove the most amenable to the psychotherapeutic approach.

The patient was a young business man of thirty-three who had shown neurotic character trends throughout his life. Numerous accidents and manifestations of physical disease appeared to have been neurotically determined,

but he did not develop symptoms of overt neurosis until the first signs of metabolic disorder made their appearance. These were in the nature of attacks resembling anxiety neurosis several afternoons a week at about four o'clock. When his blood was examined during several of these attacks it was found to be hypoglycemic. A sugar tolerance test showed a curve of the diabetic type. Marital history during this period was full of frustration of the kind associated with an actual neurosis. A year later sugar appeared regularly in the urine and from then on, he was treated with insulin.

At the time he came for analysis he had three types of somatic nervous symptoms: 1) reactions of the autonomic nervous system which he associated with insulin "shock" in which hunger and hot flushes were prominent; 2) a series of attacks of globus hystericus appearing after the cessation of conscious libidinal desire; and 3) attacks combining these two. The degree of glycosuria often varied in response to emotional conflict, and the determinants could be studied psychoanalytically. During the analysis the patient developed a series of very interesting conversion symptoms related to his fear of erections. As the analysis progressed, these, along with attacks of anxiety, showed psychological correlations with his diabetes. The author stresses the marked resemblance of the symptoms of hyperinsulinism, which the patient showed, to the clinical picture of anxiety neurosis, and the association of hyperglycemia and glycosuria with the conversion of this anxiety into somatic hysterical symptoms.

In addition to the symptoms mentioned, anxiety also took the form of phobic trends (anxiety hysteria), and tics appeared. Though not an alcoholic in the strict sense of the word, the patient had definite tendencies in this

direction which linked up with his diabetes, particularly with the taking of insulin. The analysis was interrupted after a fifteen-month period with the intention of later completing it, which was never carried out. The interruption, though rationally explained, seemed to have been due to strong unconscious resistance toward the clearing up of his diabetes. A later report from the patient indicated the disappearance of his obvious neurotic symptoms but the persistence of the diabetes. The author raises the question of whether the diabetes may not have represented the last stand of the neurosis. He advances the hypothesis that the diabetes represented a metabolic version of an actual or physioneurosis due to libidinal stasis.

Following the paper a detailed report is given of an interesting discussion of the problem. It was brought out that the case could not be considered typical for diabetes because it belonged to the group in which automatic nervous phenomena predominate, although it was diagnosed diabetes by both Dr. Geyelin and Dr. Joslin who saw the case. Dr. Earl Engle discussed the status of hormonal assays, which had been touched on in the paper, and the feasibility of applying them to such a case. Dr. Robert Fliess reviewed the symptomatology in relation to the concept of anxiety neurosis. Dr. Abram Kardiner ventured the hypothesis that such an "illness may be the end result of a series of inhibitions whose nature we do not recognize, but whose effect is detectable in stasis phenomena with efforts of ego regressions". Dr. S. E. Jelliffe stressed the prominence of oral aggressive trends in diabetics, and raised the question of the relation of this to psychosis and irreversible reactions.

One of the most frequently presented problems encountered in the clinic is the patients' reactions to the discovery

that they have diabetes. Depression and varying hypochondriacal trends appear, and an initial period of adjustment must take place. Herskovitz (21) points out the importance of re-educational methods and encouragement at this point, and maintains that classes instituted for instruction in matters of diet or regimen are among the greatest aids in helping the mental hygiene of the diabetic patient.

Protamine insulin, in cutting down necessary injections from between two and four to one a day, has relieved much of the strain and embarrassment contingent on the taking of insulin. Looney and Glass (34) have demonstrated its contribution to the treatment of diabetes in psychotic states.

The refractory patient who disregards rules of diet often calls for careful psychiatric study, as the usual disciplinary approach may tend to aggravate the situation unless social and personality factors can be carefully evaluated. An example is the case of an adolescent boy whose failure to adhere to diet and regimen threatened to lead to his expulsion from the clinic for lack of cooperation. Not only was the embarrassment of leaving group games and abstaining from having an occasional snack with the other boys a factor, but also his revolt from an apprehensive family atmosphere. The boy's parents utilized the situation to apply sweeping and unnecessary prohibitions on activity which had nothing to do with the problem of the diabetes. A normal adolescent revolt and assertion of independence was being fought along a losing front because of the confusion of issues. Some explanation and counsel to the mother and patient, with the awakening in the patient of self-interest in this combined battle against parental and medical authority, considerably lessened the tension.

An interesting addendum to the his-

tory of another refractory patient, as well as a hint on the usefulness of relaxation therapy in diabetes, is furnished by Dunbar (16). The patient was an Austrian Jewish seamstress of forty-three years who had been treated for diabetes for seven years.

"In addition to her diabetes, she had suffered from pain around the heart, shivers and pain in the left shoulder and arm (which had been considered diabetic neuritis), numbness of the tongue, the left hand and of her leg, attacks of dizziness and headaches. These symptoms had come on suddenly twenty-one years previously when she received news of her father's death in the war. In general they had become progressively worse but with marked exacerbation at the time of certain events in her life. This patient was rather uncommunicative, and showed a high degree of muscle tension. When put on the examining table and asked to relax, she burst out crying and showed extreme anxiety. Later she said: 'I feel safer when I am stiff. My "aggravations" don't bother me so much. That's why I go to sleep stiff like that, only when I wake up in the mornings sometimes I can hardly get out of bed'. After this the patient became communicative; this point is stressed because of the well-known rôle of muscle tension in connection with the attitude of being on guard, resistance, and repression".

The patient had been originally referred because she was refractory in following her diet. She explained to the psychiatrist that she knew that diet had little to do with the amount of sugar because she had made an experiment by eating all sorts of foods that were supposed to increase the sugar, had a test made at a drug store, and only a faint trace of sugar was found. On the other hand, another day when she had a lot of "aggravations"—"so

many aggravations that they made me feel as if I must have sugar"—she went to the drug store and found a four plus sugar. This made her decide not to bother with her diet. She explained that, of course, the doctors would not understand this. The writer states that her life followed very much the pattern to which attention had been called in connection with diabetes by the author and associates, namely, a "steady grind of fatigue and deprivations with an increase in passive personality tendencies. Her resentment was constantly called into play by life situations, not deeply repressed and unconscious as is usual with hypertensive patients". The major aggravations, as she called them, in her life situation were summarized and discussed in relation to treatment. "In the course of treatment the patient developed conversion symptoms not peculiarly associated with diabetes such as inability to walk, and now and then aphonia. The original hysterical symptoms cleared up with relatively superficial psychotherapy and she began to lose weight, the polyuria disappeared and the diabetes began to improve".

The systematic use of relaxation therapy in diabetes is reported by Bauch (7). He points out that sugar excretion is frequently the reaction of the patient to external and internal, particularly emotional, stimuli, and that tension and irritability are common in the diabetic. It is a well-established experimental fact that sugar metabolism can be strongly influenced psychologically, and the literature on the use of hypnotic suggestion in diabetes as evidence of this fact is cited.

The results obtained through hypnotic suggestion are the main inspiration of Bauch's method. It does not differ greatly, however, from that developed by Schultz as "autogenous training" and the "progressive relaxation" advocated by Jacobson whom the



author does not mention. Jacobson<sup>3</sup> calls attention in his book to the fact that diabetic patients often display an extraordinary degree of restlessness and anxiety, and states that relaxation therapy is indicated. However, he does not discuss the problem at length. The aim of the various methods is to bring about a general state of relaxation through training in the systematic consciously directed relaxation of individual parts, such as arms, legs, trunk, etc. The final aim of such relaxation is reduction of muscle tonus which, at first, is associated with sensations of heaviness, finally leading to pleasant general feelings of rest and freedom and lack of consciousness of the body.

Three ten-minute exercises, two hours apart, were used daily by Bauch in the clinic. After the exercises had been learned the patient was encouraged to keep them up outside. Bauch stresses the fact that this is something the patient can learn to do, and it does not have the drawback of dependence on the physician which hypnotism encourages. The state of mind engendered is one between sleep and waking. The physician utilizes this, as in hypnotism, to suggest to the patient that he should expect particular healing results from the relaxation exercises. The patient is expected to continue this attitude of mind later, without the physician, as a form of autosuggestion. Hypnotism is not generally used, though it can be utilized if it is important to speed up the process. Bauch describes the method in some detail, and believes that it can be practised successfully by any physician with psychological understanding and ability.

Seven cases are reported with accompanying charts. The amount of insulin was cut in quantities of from 10

to 60 units with increases in total carbohydrate intake. One case, a forty-five-year-old official who had been stabilized at 60 grams carbohydrate and 60 units of insulin, slept only with strong sedatives. Five and a half months after the beginning of the exercises, his urine remained constantly sugar and acetone free without use of insulin. He slept without sedatives, he was greatly relieved to be freed from the necessity of taking injections, his hypochondriacal attitude had disappeared, and there was improvement in general behavior including working ability. A year after commencing treatment he was still holding his improvement. It was the common experience to find patients' irritability and insomnia decreased, with noticeable improvement of mood. Several experiments with healthy medical students, with an attempt to decrease blood sugar level below normal by means of relaxation exercises, gave negative results. In case of outstanding neurotic conflict preliminary psychotherapy is advocated.

The findings in these experiments would serve to further emphasize the tension operating in many cases of diabetes and the importance of dealing with it. The relation of tension to its conscious manifestation as anxiety has been alluded to elsewhere. Bauch points out the great difficulty in correctly controlling and evaluating any method of treatment applied to diabetes but the work appears to have been carefully done with attention to such factors as could be controlled. The rôle of suggestion in the treatment is very difficult to evaluate, but the importance given it by the author seems to be over-rated. In other conditions such as hypertension, good results have been reported by Jacobson by the application of the progressive relaxation alone. Bauch's application of the method to diabetes is simply a variation of its use in other

<sup>3</sup> "Progressive Relaxation" by Edmund Jacobson; The University of Chicago Press, Chicago, Illinois, Second Edition, 1939.

conditions showing tension. The advocates of the method all lay stress on the "do it alone" element which gives the patient the satisfaction of helping himself and minimizes dependence on the physician. It is important to have the psychological determinants of such treatment more clearly established. The presence of the physician during demonstrations, and later when the exercises are done alone, the mental association of the treatment with his person, must contain important transference elements, some of which could be profitably exploited for more fundamental psychotherapy. What seems clear is that any systematic approach to the psychotherapy in diabetes should include relaxation techniques of which relaxation exercises and the position assumed by the patient during the psychoanalytic hour are variations.

#### SUMMARY

In this attempt to report present trends in the evaluation of the psychic factor in diabetes mellitus, the experimental, general medical and psychiatric literature of the last five years has been combed. A considerable amount of space has been given to the experimental field because at the present time it appears to hold out the best prospect of ultimately furnishing the key to the psychosomatic problem presented. Impetus was furnished to all branches of research in metabolism by the discovery of Houssay and Biasotti in 1931 that diabetes of depancreatized animals could be attenuated and their lives prolonged by extirpation of the anterior pituitary gland.

Houssay's work and its consequences have revolutionized theories of the mechanism of diabetes and have led to the relinquishment of the simpler insulinogenic concept. This has broadened the base for the understanding of the influence of emotional factors.

Numerous extracts of the anterior pituitary affecting metabolism have been described. One of the most important extracts is made from crude gland which has a diabetogenic effect on the normal animal. Young, by a series of brilliant experiments, has shown that repeated injections of such extracts result in a permanent diabetic condition after treatment is discontinued.

Many modifications of the original Houssay experiment have been tried to test the diabetogenic influence of other participants. Long believes that the adrenal cortex is essential. A modification of the diabetic condition similar to that effected by Houssay and Biasotti has been obtained by bilateral injury to the hypothalamus. Other evidence of implication of the hypothalamus in disturbed sugar metabolism, its importance as a center for the involuntary nervous system and its participation in automatic emotional discharge make it a focal point in attempts to understand degrees of emotional participation in diabetes.

Studies in the hereditary factor in diabetes show quite conclusively the importance of a diabetic anlage and there is some evidence that this may be passed on as a recessive Mendelian trait. In evaluating the emotional factor in the etiology of the disease the constitutional predisposition should be taken into account. It seems unwarranted, however, to dismiss the importance of the psychic factor either on account of hereditary predisposition or on the evidence of the World War that shell-shock is not an important etiological factor. Recent general medical literature, except in arguments along these lines, is silent on the subject.

Recent psychiatric contributions to the subject, though scattered, show an awakened interest with a new approach afforded by psychoanalytic insight.

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Emphasis is away from settling the whole question of psychogenesis in diabetes on the frequency of traumatic diabetes but is laid rather on the presence of anxiety, concealed or overt, which is unable to discharge through the conscious voluntary system and is forced through regressive changes to discharge at more primitive autonomic levels. It is well established that emotional changes can affect the blood sugar level. Up to the present time it has not been definitely proved whether or not it is possible to precipitate a diabetes by such influences. Cases in which emotional disturbances seem of importance in the causation of diabetes are cited including the first report of a case of diabetes to be psychoanalytically investigated.

A review of psychotherapy in diabetes is made. The importance of attention to personality factors in the uncooperative case, as well as in those cases which react to emotional conflict with increased sugar, is stressed. An outline of an attempt to deal systematically with emotional tension in diabetes is reported.

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REVIEWS, ABSTRACTS AND CORRESPONDENCE

*Periodical Literature*

DANIELS, GEORGE E.: Analysis of a case of Neurosis with Diabetes Mellitus, *Psychoanalytic Quarterly*, 1936, vol. 5, pp. 513-547.

A thirty-three year old married businessman was referred to psychoanalysis because of a severe neurosis associated with diabetes. He was observed over a period of fifteen months, during which he had 218 analytic hours. The patient did not suffer from a typical case of diabetes but one which belonged to a small group which is characterized by the prominence of autonomic nervous symptoms. A period of hyperinsulinism preceded the appearance of sugar by many months. Then his blood sugar was up to 233 and the patient needed 50 units of insulin daily. The patient by himself had made the observation that excitement usually caused sugar to appear in the urine. Once during the analysis he was able to talk to his father and clear up a number of things and immediately after that the sugar disappeared and he even had an insulin shock. Usually the experience of an apparent injustice led to the appearance of sugar. The author is of the opinion that the diabetes represented the last stand of the neurosis and that he had a very strong resistance to give it up. One of the last dreams of the patient during analysis was concerned with the fear that all his insulin was in danger of being used up. After the end of the analysis the patient was sugar-free for six months. After that he was free from nervous symptoms, but the diabetes returned. The life history showed an extremely shy and repressed child whose nickname was "the preacher" and who was accustomed to pacify his mother in family situations. At the age of ten he got a severe castration shock after which he gave up masturbation. To his first heterosexual experience he reacted with an asthma attack. He was frustrated both in marriage and his work and shortly before the onset of his neurosis and diabetes he felt that it would

be a relief to be ill. The sexual repression was so complete that even the usual form of hysterical conversion was not acceptable for the patient. He may be called a strong oral character but even his oral traits were so strongly repressed that for instance the development of alcoholism was not possible. The conflict was acted out largely at the metabolic level and stabilized at this level by the erotization of the anxiety.

In the discussion Dr. Bertram D. Lewin made the remark that the first discovery about diabetes by Minkowski was based on psychological observation and the first dog without the pancreas was a "problem dog". Dr. Robert Fliess tries to clarify the symptoms in 1) purely diabetes symptoms and 2) purely psychic symptoms; as for instance the tics, choking sensations and 3) ambiguous symptoms; cessation of libido, flashes and anxiety. Dr. Smith Jelliffe spoke of one case which during periods of depression did not show any sugar but who in the well periods had a definite diabetes mellitus which again and again cleared up with the onset of a depressed period.

M. G.

WILSON, GEORGE W.: The Transition from Organ Neurosis to Conversion Hysteria. *International Journal of Psychoanalysis*, 1938, vol. 19, pp. 23-40.

The term "conversion hysteria" is restricted to symptoms occurring in the voluntary and sensory systems and the term "organ neurosis" is used in reference to function disturbances of organs whose functions are autonomic and under normal conditions not subjected to voluntary influences. In organic neuroses the psychological factors involved are definitely pregenital in character, whereas in conversion hysteria later phases of instinctual organization are prevalent, more specifically the phallic phase. The author reports in detail about the analysis of a woman 41 whose gastric symptoms (peptic ulcer) changed during

the course of treatment to conversion symptom and before the cure occurred. The transitory hysterical symptom was characterized by a spasm of the muscles of the lumbar region. During this period the patient was forced by analytic insight and some active encouragement by the analyst to face the problem of heterosexuality from which she had previously regressed to a dependent attitude toward the older female members of her family. This conversion hysteria symptom expressed a fantasy of incorporation of the male genital with intense guilt feelings as a reaction to this incorporation. As this unconscious material was compared with material which appeared at the beginning of the analysis in connection with the gastric symptoms, striking differences could be observed. The character of the material connected with the organ neurosis was pregenital in character and centered about the dependent demanding attitude towards the patient's older sister.

M. G.

SAUL, LEON J.: Psychogenic Factors in the Etiology of the Common Cold and Related Symptoms, *International Journal of Psychoanalysis*, 1938, vol. 19, p. 451.

Evidence is presented which confirms the observation that emotional factors may be of prime importance in certain cases of the "common cold" (including sore throat and laryngitis) (*i.e.* the "cold" may be essentially a neurotic symptom).

That psychogenic factors may be of appreciable frequency and importance in the etiology of colds is indicated by a brief statistical survey of the practices of six psychoanalysts: every one of fifteen patients who had repeated colds before analysis, had few or none in three years after analysis.

In the nine patients reported, colds occurred regularly in situations of frustration of strong, mostly unconscious, receptive demands with more or less repressed rage. In the opinion of the author, the evidence in these cases shows that the relationship is causal. This observation in no way implies that all emotional states of receptive thwarting result in colds, nor obviously that this etiology is in any sense exclusive.

The emotional factor is only one of several.

The emotional impulses stimulate physiological activities in other regions of the body. These result in the other symptoms which frequently accompany colds: gastrointestinal disturbances (anorexia, nausea, diarrhoea, colitis, constipation), headache, and in women, leucorrhoea. The fatigue, malaise, etc., are often, at least in part, manifestations of mild depression. Fever, apparently truly psychogenic, occurred in two cases. The whole condition is utilized in the services of masochism, passive indulgence, secondary elaboration and various other secondary gains. Some incidental observations are made on psychogenic factors in catarrhal vaginitis and leucorrhoea.

M. G.

GROTJAHN, MARTIN and FRENCH, THOMAS M.: Akinesia After Ventriculography, A Contribution to Ego Psychology and the Problem of Sleep, *The Psychoanalytic Quarterly*, 1938, vol. 7, pp. 319-329.

Stages of akinesia occurred in seven patients after the third ventricle had been filled with air. All seven patients had brain tumors localized around the third ventricle. The neurological findings were similar in all the cases and ventriculography revealed internal hydrocephalus of high degree in all of them. The akinetic patients did not move spontaneously; even the eyes were not moved and the winking reflexes were not obtainable. The patients could not eat unassisted and were incontinent of faeces and urine. Yet their consciousness was undisturbed; they were able to answer questions and could give information about their feelings, experiences and dreams.

The x-ray findings, the neurological symptoms, other pathological symptoms and the autopsy of one of the cases support the opinion that the underlying pathological process, which may be considered as being the cause of the akinesia, may be localized in the hypothalamic region. This localization is confirmed by neuropathological studies of encephalitic patients suffering from a similar kind of akinesia.

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have in common with *sleeping* persons complete lack of initiative and will power, passive attitude and indifference, lack of response to stimuli from the outer world, withdrawal of libidinal interest from reality and the external picture of quiet, emotionless and happy rest. The bodily ego feeling is absent, and the akinetic person has no knowledge of the lack of bodily ego feeling. Therefore, the akinesia is to be compared with a *bodily sleep*. The two different forms of awakening, mental and bodily, are sometimes observed separately under certain conditions even in normal persons.

These observations make clear the possibility of dissociations between the cognitive and volitional aspects of the ego's synthetic activity and should stimulate comparison with other forms of dissociation of the synthetic function of the ego as seen in dreams and in psychotic states. Of particular interest is the relation between such dissociations of the synthetic function and the processes of sleep and awakening.

#### Book Reviews

PRATT, CARROLL C.: *The Logic of Modern Psychology*. New York: Macmillan, 1929, pp. xvi+182. \$2.00.

The work represents a critical examination of the basic assumptions of psychology. Its salient points may be considered separately.

1) Psychology has no unique subject matter. The subject matter of all sciences—physics, physiology, or psychology—is the same, namely the world of experience. The distinction between scientific fields is based only on a more or less convenient division of labor. One may admit with the author the identity of the initial data for the various sciences and still not follow him in his conclusion that the division of the fields of science is arbitrary. It is not the subject matter which characterizes a science but rather the point of reference and the types of relationships which are studied. Pratt overlooks the fact that the data of experience have not only relations to each other but are also related to a central point, to the "ego". Psychology is concerned primarily with subject-dependent relationships.

The problem of meaning which is rightly considered as specifically psychological, cannot be comprehended without reference to a self. Pratt disposes rather lightly of this problem. He states that meanings involve one type of relationship and the study of items in relation is not characteristic of psychology, but is general for all sciences. He formulates the relation involved in meaning as: A stands for B. This formulation, however, is incomplete. Meanings involve triadic relations, *viz.*, A means B for C (*i.e.*, for an individual). A and B are not related directly to each other but only through the person who is able to comprehend and create symbolic links. If the ego is eliminated from this relationship the two items, A and B, lie apart, entirely unrelated.

2) "Only physiology can furnish an explanatory frame of reference for the facts of psychology." (p. 131) "In proportion as the experimental work of psychology becomes exact it will inevitably be absorbed into the more basic discipline of physiology." (p. 134) Since explanation is a statement of the antecedent conditions for the event in question, it is not quite clear to the reviewer why they could not be stated in psychological terms just as well as in physiological terms. The author's point of view may be correlated with his aforementioned disregard of the unique character of psychological relationships.

3) The initial observations form only the point of departure for scientific work; the next important step is the formulation of explanatory concepts stating the conditions responsible for the appearance of a given event. Psychological concepts are best defined operationally: on one side of the equation stand the experimental observations and operations, on the other a word or phrase designated to comprehend them.

4) Since only physiological explanation is scientifically acceptable, one can tell very little as yet about complex forms of behavior. Consequently, the application of psychology to practical problems is in most instances premature.

There is a real need in psychology for a logical clarification of the basic concepts

and assumptions and Pratt's contribution appears to be very significant in this respect. Some of the points of view expressed by him are subject to criticism but deserve serious consideration nevertheless. The book will make profitable reading for all those who are interested in psychology and sciences related to it.

A. A.

SKINNER, B. F.: *The Behavior of Organisms: An Experimental Analysis*. New York, D. Appleton-Century Company, 1938, ix+457 pp., \$5.00.

This is a challenging book with all the earmarks of a truly original approach to the complex problems of behavior. Since it attempts both a systematic formulation and an experimental demonstration of basic psychological issues it must be read carefully to be appreciated. Acquaintance with the previous work of the author, which culminated in this volume, helps even more perhaps than careful study of the book itself in conveying a sense of its significance. For this background one must look first to the doctor's thesis accepted by Harvard University in 1931. Here the concept of the reflex as redefined by the author had a leading role. Subsequently Skinner spent several years as Fellow of the National Research Council and as Junior Fellow in the Society of Fellows at Harvard University, most of which time was devoted to following up the program outlined in the thesis. A vast body of experimental data was thus accumulated and forms the basis of the behavioral system presented in the present work. Most of the studies fall under the rubric of conditioning. White rats are used as subjects and a lever-pressing situation with food pellets for rewarding successful activity provides the characteristic content.

After stating the chief purpose of the book in the first chapter, entitled "A System of Behavior", the scope and method of the work are outlined. A series of some eight or nine chapters, generously filled with experimental graphs, follows and affords data on such topics as conditioning and extinction, reconditioning, discrimination, the differentiation of responses, drive, and other variables affecting reflex strength.

The final two chapters reiterate the author's attitude toward neurological formulations in the science of behavior and summarize the main findings of the book, respectively.

If viewed from the standpoint of the animal laboratory the volume might be regarded as a monograph reporting various investigations which furnish information succinctly summarized in the 148 reproduced kymograph records. There can be no doubt that these data are important even at the purely factual level. The information afforded with reference to the behavior of the rat confronted with a lever-pressing problem sheds interesting light in numerous directions. More significant, however, is the systematic implication of the work and of the theoretical discussions for which the experimental investigations serve as a basis.

It is in relation to these systematic questions that the essential significance of the volume must in the end be determined. Perhaps from the standpoint of the general reader the issues of pure psychology which are involved here and which have little immediate bearing upon practical human affairs may contain little of interest but to the professional psychologist they are fundamental. The pivotal point of the system is found in the definition or—if Skinner is right—in the revival of the original reflex concept. To the author the reflex is not a neurological or essentially physiological unit but is to be regarded as behavioral from beginning to end, *i.e.*, from stimulus to response. It is in the repeated correlation of such beginning and end terms that the essential nature of the reflex lies, not in the intermediate unobserved factors which are usually emphasized in the textbooks as having chief importance. Skinner contends that it is possible to develop a science of pure behavior with the reflex, thus defined, as the unit and with purely empirical correlations, which have been quantitatively and experimentally determined, as a foundation. From this standpoint he outlines a number of laws, such as those of after-discharge, refractory phase, and facilitation, all of which are highly reminiscent of the work of Sherrington and Magnus but are

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by Skinner defined in purely operational terms consistent with the revived reflex concept. In this setting it is not difficult to appreciate why the author takes issue with those psychologists who give the C. N. S.—translated as Conceptual Nervous System by him—a place of honor in their theorizing. Skinner is a behaviorist in the purest sense of the term. For him explanations are adequately found in the correlation of behavior items. Relationships to neurological factors are obviously not denied but the business of the psychologist is regarded as heuristically independent of and demarcated from that of the neurologist. The consistent and precise results which Skinner has been able to obtain from his experimental work lend considerable weight to his theoretical position.

One of the most stimulating of the discussions in the book concerns the distinction between respondent and operant behavior. These two fundamental types of activity are distinguished by the fact that respondent behavior is regarded as elicited by precise and explicit stimuli, whereas operant behavior is thought of as being emitted more or less spontaneously from within the organism. The latter or operant kind of reflex can be readily studied quantitatively by relying upon the variable of time, *i.e.*,

rate of response. "The use of a rate", says Skinner early in the book, "is perhaps the outstanding characteristic of the general method to be outlined in the following pages. . . ." A corresponding distinction between two types of conditioned reflex completes the scheme. Type S, for which the work of Pavlov is representative, depends upon the approximately simultaneous presentation of two *stimuli* one of which is substituted for the other. Type R, which is found characteristically in Skinner's own work, depends upon the correlation of a reinforcing stimulus with a *response*. In other words, the reinforcing stimulus is here contingent upon a response whereas in Type S conditioning, the reinforcing stimulus is present practically from the beginning.

The volume adopts a definitely individualistic approach to the fundamental problems of behavior. Skinner's work has already had considerable influence in its natural province. How much further it will go can only be determined by the simultaneous fate of competing systems. Perhaps a somewhat fuller appraisal of these latter might have helped to orient the reader though it would inevitably have blurred the uniqueness of the author's own position.

S. R.

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- ALLEN, CLIFFORD: Modern Discoveries in Medical Psychology, Macmillan.  
 BILLINGS, EDWARD G.: A Handbook of Elementary Psychobiology and Psychiatry, Macmillan.  
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 PREU, PAUL W.: Outline of Psychiatric Case-Study, Paul B. Hoeber, Inc.  
 ROBINSON, G. CANBY: The Patient as a Person, The Commonwealth Fund.  
 RORTY, JAMES: American Medicine Mobilizes, W. W. Norton Co.  
 TULCHIN, SIMON H.: Intelligence and Crime, University of Chicago Press.

## TO THE EDITOR:

In the *Journal of the American Medical Association* of April 22, 1939 (p. 1625), will be found, in the column entitled "Queries and Minor Notes," an interesting example of psychological scotoma.

The inquiry concerns a 32-year-old miller who has asthmatic attacks only at night and when his wife is in the house. We are informed that he had no attacks before meeting his wife nine years ago, that he has had since then 42 negative pollen and food-diagnostic tests, that propinquity to other women does not bring on attacks, but that in spite of the elimination by his wife of cosmetics and certain types of clothing, the attacks still persist in her presence.

A rather lengthy answer is given to this interesting query, suggesting the avoidance of perfumes and of contraceptives as possible sources of the allergy, and the carrying out of many more skin tests, since "only forty-two" have already been carried out. The answer starts with the statement: "The evidence given would certainly seem to incriminate something associated with the wife." The rather startling feature of the answer is, however, that it omits entirely any suggestion that possibly the attacks are psychogenic in origin and have something to do with the emotional relationship which exists between the man and his wife.

## CORRESPONDENCE

In the *Psychiatric Quarterly* for July, 1939, Dr. Robert B. Sampliner, in an article entitled, "The Psychic Aspects of Bronchial Asthma," reviews the literature dealing with this topic. He indicates no less than five possible psychic factors in bronchial asthma, namely, 1) A conditioned reflex; 2) the expression of a mental conflict with the organ; 3) the use of the disease by the asthmatic for the purpose of gaining his own conscious ends; 4) the result of suggestion or imitation; and 5) the result of psychic trauma. He summarizes from the literature 23 cases of recovery under psychotherapeutic treatment, 3 cases with improvement, 2 cases without result, and 15 cases in which relapse after apparent recovery occurred. The literature on the topic is extensive, indeed, and it would seem unfortunate that the allergist who answered the query of the miller's doctor had apparently read none of the numerous articles which have appeared from time to time on the psychic factors.

This case illustrates the fact that in the minds of too many physicians there still exists the notion of a complete separation between the psyche and the soma. It furnishes, too, an eloquent argument for the existence of a magazine like *PSYCHOMATIC MEDICINE*, which is dedicated to the purpose of closing this gap.

WINFRED OVERHOLSER, M.D.  
*Saint Elizabeth's Hospital, Washington, D.C.*  
August 4, 1939

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# PSYCHOSOMATIC MEDICINE

[PSYCHOSOM. MED.]

OCTOBER · 1939  
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### ERRATA

Vol. I, No. 1, January, 1939, page 31, first column, lines 31 ff. should read: . . . When, therefore, the intact nervous system is visualized, a mental picture is conjured up of two great interlacing systems, etc.

Vol. I, No. 3, July, 1939, page 423, footnote should be run to title reading: I should like to express my appreciation to PSYCHOSOMATIC MEDICINE for its initial suggestion of the need for this review and its encouragement in the undertaking.

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## NOTE

The field to which PSYCHOSOMATIC MEDICINE is devoted is rapidly assuming importance in medicine and the related sciences. The traditional body-mind dichotomy is now less present in medical thinking, although not eradicated from language. Expressions which are gaining increasing prominence in medical literature, such as the organismal-theory, the patient as a whole, psychosomatic problems, psycho-physiology, psychobiology, are all attempts to avoid the artificial division of psychological from the physiological. Although the organism is a unit, fundamentally different methods have been developed for the understanding and management of the psychic and somatic functions.

From the earliest days of medicine those methods which related to management of the psychic aspects of patients have been called the art of medicine in contradistinction to what has been thought of as the science of medicine. Recent studies of emotional factors in the etiology and course of organic illness have demonstrated that the scientific method is as essential to satisfactory management of the psychic as of the somatic aspects of the organism's functioning. It now seems increasingly clear that neither one of these two aspects can be isolated. The fact that studies relating to them tend to be isolated from each other in our scientific literature constitutes the reason for this publication.

## PREPARATION OF MANUSCRIPTS

Manuscripts should be typewritten in double spacing with wide margins, on one side of paper 8 1/2 x 11 inches, and should be packed flat. Tables, case histories and other subsidiary matter usually set in smaller type than the text should be typewritten on separate sheets and placed with the text in correct sequences. Footnotes and legends for figures should be typewritten on separate sheets at the end of the text copy. Case histories and protocols should be written in clear, concise statements in the past tense and not in incomplete sentences and disjointed phrases. *Promptness of publication can be assured only if manuscripts are submitted in duplicate.*

Bibliographical references should be listed alphabetically at the end of the paper, numbered serially. Each reference should appear in the following manner: author's name, title, journal abbreviation (as given in the World List of Scientific Abbreviations), volume (in Arabic, underlined), pages and year. When these articles are cited in the text, only the author's name should appear and after it the serial number in parenthesis, underlined. Authors are urged to verify personally the accuracy of the references, using only the original sources.

With each article there should be a summary of usually not more than 250 words, suited to the needs of abstract journals. This summary should be intelligible without reference to the body of the article.

A certain number of tables will be allowed without charge. Arrangements must be made with the Managing Editor for illustrations and excess tables.

All illustrative material should be submitted in finished form for photographic reproduction without retouching, redrawing, labelling or the setting of marginal type (with the exception of the legend below the figure).

Original drawings, not photographs of drawings, should be sent. These should be made on white heavy paper or bristol board and should be arranged to conserve vertical space, made conformable to the format of the journal.

When photographs are used for half-tone reproduction glossy prints with as sharp contrast as possible should be submitted unmounted. All unnecessary material should be trimmed away. Actual magnifications of photomicrographs should be given. In grouping illustrations it should be borne in mind that text figures after reduction cannot exceed the dimensions of the printed matter on the page, 5 3/8" x 8". The preparation, arrangements and trimming of illustrations and the arrangement of tabular data so as to conserve vertical space on the page is especially urged. The author should place his full address at the top of the first page of the manuscript, and his name on the back of each photograph or drawing.

The Editors reserve the right to refuse any manuscript submitted, whether on invitation or otherwise, and to make suggestions regarding modifications which will make publication more practical.

## PREPRINTS

An arrangement has been made whereby authors may receive both prompt publication and preprints, that is, reprints of their articles will be mailed before the number of the journal in which they are published is distributed. To make the journal really cooperative and in return for these advantages, it is expected that each author will agree to purchase either personally or through his university or institution at least 200 such preprints. It is hoped that in this way the low subscription rate can be maintained.

## MONOGRAPHS

- I. Benjamin V. White, Stanley Cobb and  
Chester M. Jones: Mucous Colitis—A  
Psychological and Medical Study of  
Sixty Cases .....\$2.00

### Monographs in Preparation

- II. Ephraim Shorr and George W. Henry:  
Psychic Concomitants of the Ovarian  
Insufficiency.
- III. W. Horsley Gantt: The Origin and De-  
velopment of Behavior Disorders in  
Dogs.
- IV. Thomas M. French and Franz Alexander:  
Psychogenic Problems in Bronchial  
Asthma.
- V. Howard S. Liddell, O. D. Anderson,  
Arthur M. Sutherland and Richard  
Parmenter: Comparative Physiology of  
Experimental Neuroses.
- VI. Therese Benedek and Boris B. Rubenstein:  
Relation of Ovarian Function and  
Emotional States.
- VII. Pauline A. and Hallowell Davis: The  
Electroencephalogram and Its Impli-  
cations.



